Arthur Stanley House
Sustainability and Energy Statement

Westbrook Partners / 1921 Mortimer Investments Limited

December 2017

Sustainability & Energy Statement

(Incl BREEAM LZC Feasibility statement)

1921 Mortimer Investments Ltd

FOR THE SITE AT:

Arthur Stanley House
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Executive Summary

This Sustainability and Energy Statement has been undertaken by SRE & Green Building Design Consultants for the Proposed Development at Arthur Stanley House, London for 1921 Mortimer Investments Ltd (the Client) in order to meet the Planning Policy requirements of the London Borough of Camden Council.

Sustainability issues relating to the site as a whole, the construction process, building design and operation have been considered.

In particular, the energy and water efficiency measures for the Proposed Development have been assessed in some detail.

This statement assesses 'Best Practice', energy efficiency measures and renewable energy solutions for the Proposed Development. The inclusion of energy efficiency measures has been discussed to minimise on-site energy use compared to a building regulation compliant design. These include improved insulation levels, high specification glazing and energy efficient lighting and appliances.

The feasibility of incorporating low and zero carbon energy sources has also been assessed with PV installations on the flat roof of both the office block and residential block being proposed for the site.

SAP and SBEM calculations have been carried out to confirm the energy strategy delivers a high standard of fabric efficiency in conjunction with high efficiency heating systems to exceed Building Regulations 2013 Part L compliance for the commercial and residential units.

Water efficiency measures have been considered and the Proposed Development will achieve a predicted water consumption of no greater than 17.61 litres per person per day for the commercial units and no greater than 110 litres per person per day for the residential units.

The Proposed Development will meet all relevant policies and requirements set out within the Camden Local Plan and the London Plan, the result of which is the provision of a resource efficient, sustainable development. The following standards are being proposed:

Residential Block

- A thermally efficient building fabric specification as per Table 8
- Accredited Construction Details for all applicable thermal bridges (and IG Hi-Therm lintels for the dwellings)
- Air-permeability of ~$4m^3/hr/m^2$
- A communal CHP system with a backup boiler and HIUs to each dwelling
- 6.6 kWp PV Array on the flat roof of the residential block
- AC units to provide comfort cooling
- Efficient lighting design to reduce power consumption
- Efficient water fittings to reduce indoor water demand
- Home Quality Mark 'level 3' compliance.

Commercial Block

- A thermally efficient building fabric specification as per Table 8
- Accredited Construction Details for all applicable thermal bridges (and IG Hi-Therm lintels for the dwellings)
- Air-permeability of ~5m^3/hr/m^2
- VRV system to provide heating and cooling for offices
- 10.4kWp PV Array on the flat roof of plant room
- Efficient lighting design as per Figure 10
- Separate metering for all major commercial energy loads, which includes 'out-of-range' values (minimum of heating, cooling, lighting and ventilation)
- Efficient water fittings to reduce indoor water demand
- BREEAM 2014 'Excellent' compliance overall.

Unit Type	Commercial	Residential
Energy Baseline (tonnesCO_2/ yr)	41.05	14.20
Be Lean (tonnesCO_2/ yr)	30.67	13.99
Be Clean (tonnesCO_2/ yr)	23.47	11.14
Be Green (tonnesCO_2/ yr)	19.17	9.15
Total Cumulative Savings	**53.30%**	**35.56%**

Table 1: Proposed Solution Summary

Table 1 (above), and Figures 1 and 2 (below) demonstrate that the site-wide estimated emissions have been reduced in accordance with the Camden Local Plan and the London Plan.

A 19% improvement over Building Regulations Part L1A (dwellings) and 35% improvement over Part L2A (commercial) 2013 target emissions rates, compared to a compliant gas based solution, have been achieved by implementing the "be lean, be clean, be green" national energy policy methodology.

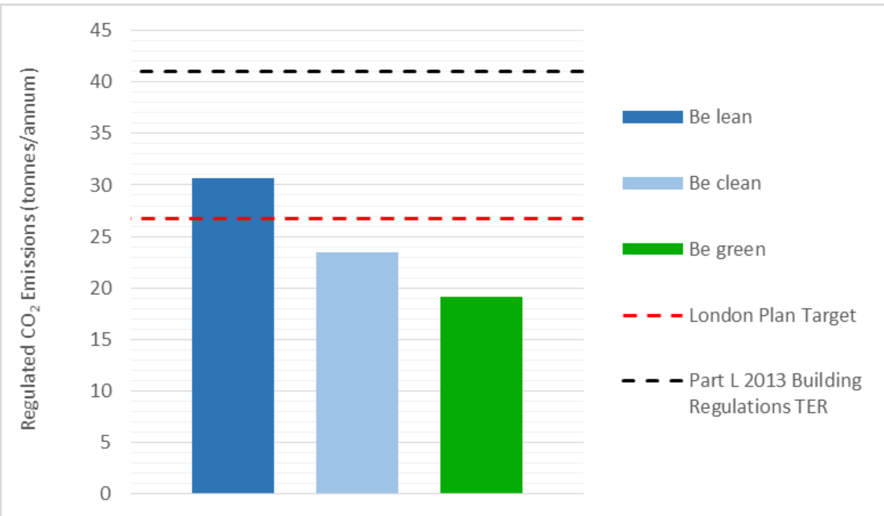


Figure 1: 'Lean, clean and green' Summary New Commercial Areas

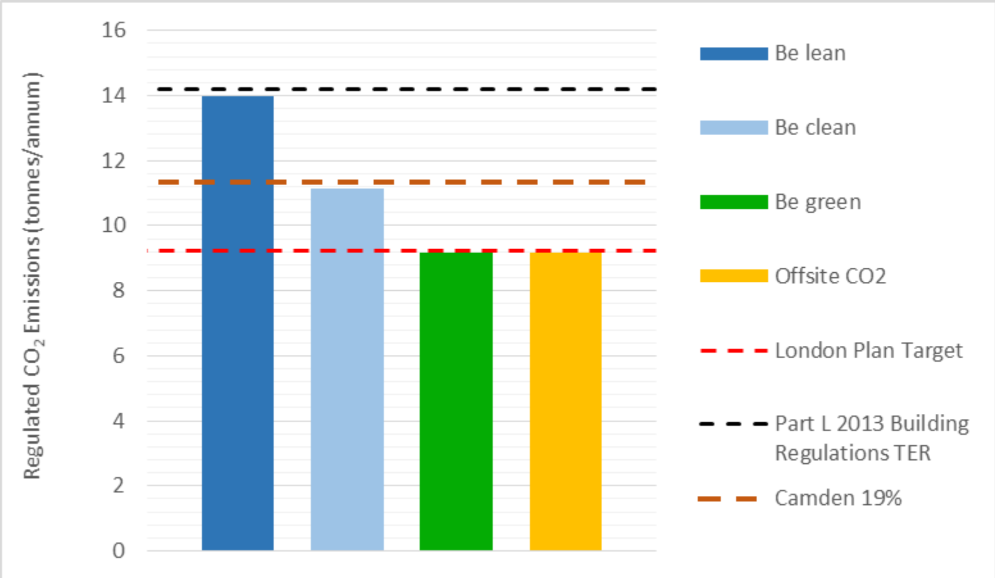


Figure 2: 'Lean, clean and green' Summary Residential Units

1.0 Introduction

1.0.1 The Sustainability and Energy Statement (BREEAM LZC feasibility report) has been prepared by SRE with Green Building Design Consultants in support of the planning application for Arthur Stanley House, Camden (Proposed Development) for 1921 Mortimer Investments Ltd (the Client).

1.0.2 The Statement provides a prediction of the Proposed Development's energy baseline requirement compared to a Building Regulation compliant design, outlines the use of energy efficiency measures, and assesses suitable renewable energy technologies in relation to the site layout, building design, energy demand and in response to the relevant planning requirements for the new build units.

1.0.3 The Statement also details how the Proposed Development responds to the relevant planning requirements as part of an overall sustainability assessment, and addresses key factors in relation to sustainability under the following headings:

- Site Location and Land Use
- Construction Processes
- Materials
- Water
- Pollution Impacts
- Health and Wellbeing

1.0.4 This statement will also address issues of a wider context such as urban design and social impacts to ensure the development relates to the community it sits in and enhances the local environment (social, natural and economic) of the surrounding area.

1.1 The Proposed Development

1.1.1 The Proposed Development at Arthur Stanley House, Camden is a mixed-use development that consists of the extension of an existing commercial building to comprise of a Basement, Lower Ground, Ground and Seven upper storeys of commercial space with a reception area on the ground floor. There will also be an additional nine new dwellings spread over a Lower Ground, Ground and three upper storeys in a separate conjoined block at the rear.

Figure 3: Proposed Development Elevations. Southeast (left) shows the façade of the commercial space, Northeast (right) shows the façade of the residential space

1.1.2 The existing site consists of a vacant former hospital building, which will be refurbished for commercial use with a rear extension added. A new building composed of one lower ground and three upper storeys is proposed to the rear for the residential units as part of the new mixed use development. The Ground floor plans for both blocks are included in Appendix A with further details within the architect's drawings.

2.0 Applicable Standards and Policy

2.0.1 The World Commission on Environment and Development (WCED) report: Our Common Future, describes Sustainable Development as development that:

"meets the needs of the present without compromising the ability of future generations to meet their own needs."

2.0.2 The broad concept of Sustainable Development is taken into account within the Sustainability and Energy Statement. However, the focus is on successfully meeting the requirements of planning policy and guidance, with key documents listed below.

2.0.3 The outline approach for the Proposed Development is to address the site wide sustainability issues with the aim of:

- minimising the Proposed Development's overall environmental impact during construction and operation
- developing housing suitable for local needs
- integrating with other local residential neighbourhoods

2.1 National Standards

2.1.1 National Standards are the legal requirements within the UK Construction industry and recent changes resulted from the Deregulation Act 2015 which attempted to streamline construction compliance issues to one overall compliance requirement under the Building Regulations.

2.1.2 These requirements replace various assessment methods previously used to demonstrate best practice in terms of design, and combine what are thought to be the pertinent issues into the Building Regulations, thus removing the need for compliance under third party assessment methodologies such as the Code for Sustainable Homes and lifetime homes.

2.2 Planning Policies

2.2.1 The following planning policy and guidance has been used to inform the strategy and to ensure that the Proposed Development meets all requirements imposed on it through Planning Policy:

- Camden Local Plan – 2017

Supporting Policies

- London Plan 2016 (including FALP)
- Mayor of London Sustainable Design and Construction SPG – April 2014
- Camden Planning Guidance 3 – Sustainability

Key Planning Policies – Camden Local Plan

2.2.2 The Sustainability & Energy Statement primarily aims to address the requirements of the Local Plan Policy CC1, with policies CC2-5 also being of relevance:

Climate Change Mitigation

Any new development in Camden has the potential to increase carbon dioxide emissions in the borough. If we are to achieve local, and support national, carbon dioxide reduction targets, it is crucial that planning policy limits carbon dioxide emissions from new development wherever possible and supports sensitive energy efficiency improvements to existing buildings.

Policy CC1 Climate Change mitigation

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

We will:

- *promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;*
- *require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;*
- *ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;*
- *support and encourage sensitive energy efficiency improvements to existing buildings;*
- *require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and*
- *expect all developments to optimise resource efficiency.*

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

- *working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;*
- *protecting existing decentralised energy networks (e.g. at Gower Street Bloomsbury, Kings Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and*
- *requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.*

The Energy Hierarchy

The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings. New developments in Camden will be expected to be designed to minimise energy use and CO^2 emissions in operation through the application of the "energy hierarchy". The energy hierarchy is a sequence of steps that minimise the energy consumption of a building. Buildings designed in line with the energy hierarchy prioritise lower cost passive design measures, such as improved fabric performance over higher cost active systems such as renewable energy technologies.

All new residential development will be required to demonstrate a 19% CO^2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

Be lean:

Proposals should demonstrate how passive design measures including the development orientation, form, mass, and window sizes and positions have been taken into consideration to reduce energy demand, demonstrating that the minimum energy efficiency requirements required under building regulations will be met and where possible exceeded. This is in line with stage one of the energy hierarchy 'Be lean'.

Be clean:

The second stage of the energy hierarchy 'Be clean' should demonstrate how the development will supply energy efficiently through decentralised energy. Please refer to the section below on decentralised energy generation.

Be green:

The Council will expect developments of five or more dwellings and/or more than 500 m^2 of any gross internal floor space to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO^2 emissions of the development after all proposed energy efficiency measures and any CO^2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

All major developments will also be expected to demonstrate how relevant London Plan targets for CO^2 reduction, including targets for renewable energy, have been met. Where it is demonstrated that the required London Plan reductions in carbon dioxide emissions cannot be met on site, the Council will require a financial contribution to an agreed borough wide programme to provide for local low carbon projects. The borough wide programme will be connected to key projects identified in the Council's Green Action for Change.

Policy CC2 Adapting to Climate Change

- *Encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;*
- *Expecting developments (conversions/extensions) of 500m^2 of residential floor space or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and*
- *Expecting non-domestic developments of 500m^2 of floor space or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.*

Policy CC3 Water and flooding

We will require development to:

- *Incorporate water efficiency measure;*
- *avoid harm to the water environment and improve water quality;*
- *utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy, unless inappropriate, to achieve a greenfield run-off rate where feasible; and*
- *not locate vulnerable development (such as basement dwellings) in flood-prone areas*

Policy CC4 Air Quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan.

Policy CC5 Waste

The Council will seek to make Camden a low waste borough. We will:

- *aim to reduce the amount of waste produced in the borough and increase recycling and the reuse of materials to meet the London Plan targets of 50% of household waste recycled/composted by 2020 and aspiring to achieve 60% by 2031;*
- *deal with North London's waste by working with our partner boroughs in North London to produce a Waste Plan, which will ensure that sufficient land is allocated to manage the amount of waste apportioned to the area in the London Plan;*
- *safeguard Camden's existing waste site at Regis Road unless a suitable compensatory waste site is provided that replaces the maximum throughput achievable at the existing site; and*
- *make sure that developments include facilities for the storage and collection of waste and recycling.*

Key Planning Policies – London Plan 2015 (including FALP)

2.2.3 The Sustainability & Energy Statement primarily aims to address the requirements of the London Plan Policy 5.2.

Policy 5.2. Minimising Carbon Dioxide Emissions

The Mayor will work with Boroughs and developers to ensure that "major developments[1]" meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

	Improvement on 2013 Building Regulations Residential Buildings	Improvement on 2013 Building Regulations Non-domestic buildings
2010-2013	19%	19%
2013-2016	35%	35%
2016-2019	Zero carbon	As per building regulations requirements
2019-2031		Zero Carbon

Table 2: London Plan CO_2 emissions reduction requirements

[1] Defined within the London Plan (2016) as developments where 10+ units are to be constructed OR where the floor area is $1000m^2$+

Key Planning Policies – Camden Planning Guidance 3 – Sustainability

Camden CPG3 is a broad advisory document that the entire range of sustainability thresholds employed by the London Borough of Camden.

"The Council is committed to reducing Camden's carbon emissions. This will be achieved by implementing large scale projects such as installing decentralised energy networks alongside smaller scale measures, such as improving the insulation and energy performance of existing buildings."

Applicability to Proposed Development

2.2.4 The Proposed Development will deliver the following sustainability and energy standards based on the applicable planning policies.

2.2.5 The residential block is considered a 'minor' residential development in the context of the London Plan requirements as it contains <10 dwellings, yet 'major' in the context of the Camden Local Plan as it contains > 5 dwellings. Therefore it is expected to achieve:

- 19% improvement over Building Regulations 2013 Part L1A.
- An additional 20% carbon offset from Low or Zero Carbon Technologies once all proposed energy efficiency measures have been accounted for.
- Home Quality Mark level 3
- General sustainability measures (CC3-5)

2.2.6 The commercial space is considered a 'major' development in both the Camden and London Plans due to the proposed new floor space being >500m^2 and >1000m^2 respectively. Therefore the full context of Policies CC1 and CC2of the Camden Local Plan and Policy 5.2 of the London Plan will be applicable for the commercial extension. The commercial space will therefore need to demonstrate:

- A 35% improvement over Building Regulations 2013 Part L1A compliance for the new extension. (London Plan)
- An additional 20% carbon offset from Low or Zero Carbon Technologies on the new extension once all proposed energy efficiency measures have been enforced. (CC1)
- A 19% improvement over Building Regulations 2013 Part L2B within the existing building.(CC1)
- BREEAM 'Excellent' rating for the new extension (CC2)
- General sustainability measures (CC3-5)

3.0 Sustainability Assessment

3.1 Site Location and Land Use

3.1.1 Site wide sustainability issues related to the Proposed Development have been considered. The Proposed Development consists of the main commercial building facing southeast with an open terraced roof on the seventh and restricted access terrace on the eighth floor, and the extensions forming terraced roofs at the rear of the building. Adjacent to this, to the northeast (rear) of the commercial building, is the proposed residential block. The footprint of the residential block is on the only existing external space (hard standing), therefore the only outdoor space would have to be located on the new rear terraces.

Contaminated Land

3.1.2 Environment Agency map data indicates no cases of pollution/contamination at the site or in the immediate vicinity (Figure 4). Whilst there are multiple sites in the surrounding area wherein radioactive substances have been permitted to be released into the sewers (mostly from former NHS and university buildings) and also an instance of chemicals being released into the atmosphere in 2002, both of these instances are unlikely to have any effect on the site in question.

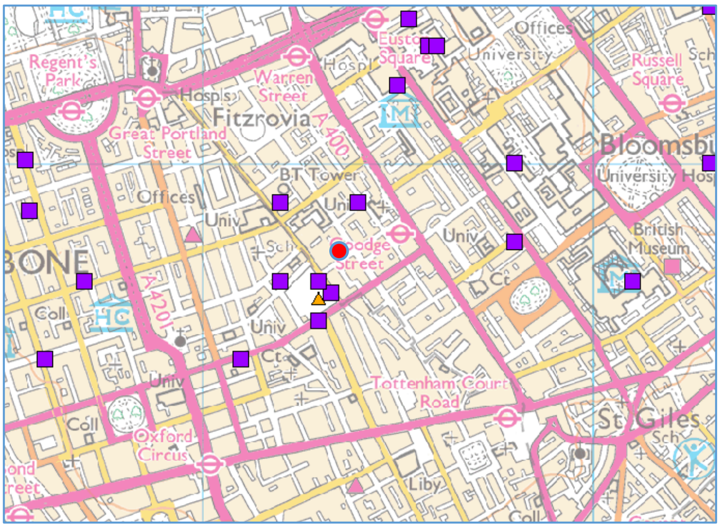


Figure 4: EA Pollution Map. Site marked by Red Circle

3.1.3 Environment agency map data also shows no sites of historic landfill disposal located at the site or within the surrounding area (Figure 5).

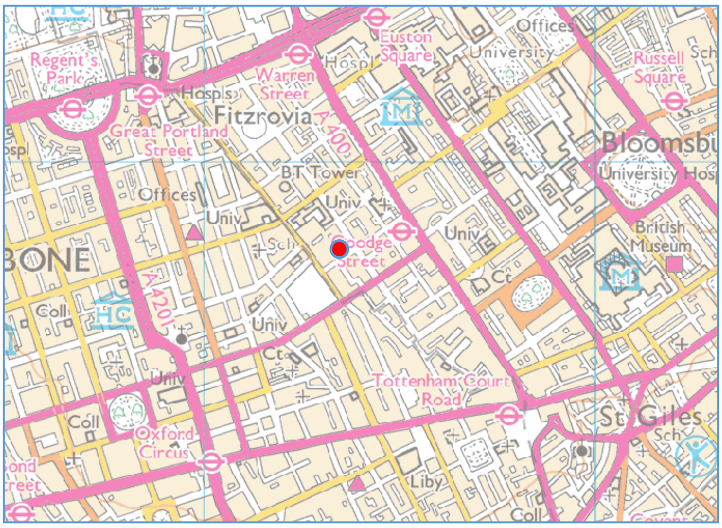


Figure 5: EA Landfill Map. Site marked by Red Circle

Flood Risk and Design

3.1.4 A Flood Risk analysis has been undertaken through the Environment Agency's flood mapping service (Figure 6) and the Proposed Development is shown to be located in Flood Zone 1.

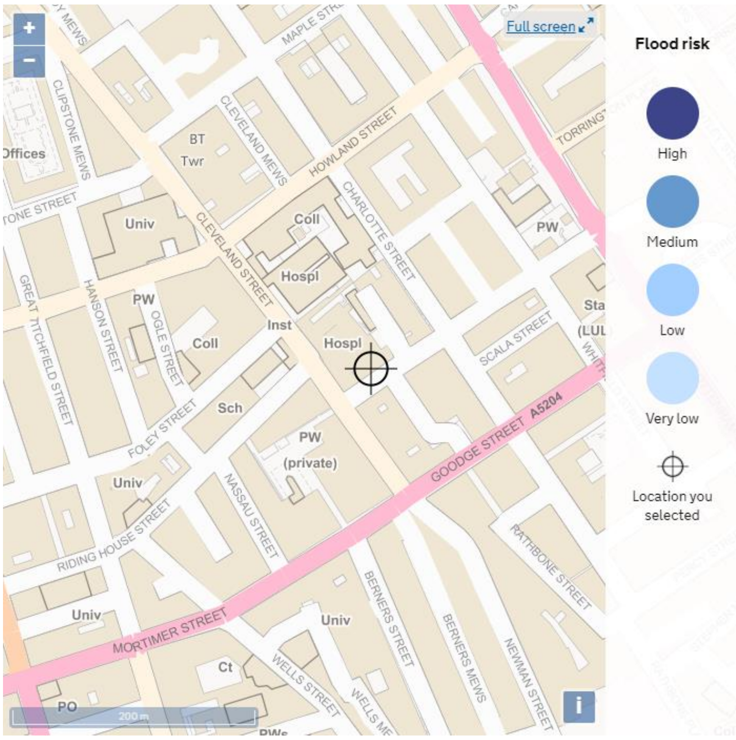


Figure 6: Flood Map – Environment Agency Flood Mapping Service

3.1.5 It should be noted that the Environment Agency's Flood Risk Mapping Service is only indicative and does not take into account the possibility of flooding from local sources and flash flooding potential.

3.1.6 As per the BREEAM Pol 03 criteria, a BREEAM compliant supplementary flood risk assessment (FRA) will be submitted as part of the formal planning application.

3.1.7 The full and comprehensive FRA will cover the risks of both on and off-site flooding to and from the development for all sources and it will demonstrate that the development will include sustainable drainage systems (SUDS) where applicable.

Biodiversity

3.1.8 As per the LE 01-05 criteria, a BREEAM compliant full and comprehensive ecology report of the on-site biodiversity (pre and post development) has been undertaken in support of the formal planning application by The Ecology Consultancy.

3.1.9 Biodiversity is generally considered to be the variety of life forms within a certain ecosystem. The proposed development currently consists of an existing office building and hard standing and is therefore expected to be of low ecological value

3.1.10 The compact urban nature and orientation of the site provides limited opportunities to enhance the ecology. However consideration will be given to enhancement measures that are feasible and appropriate to the character and context of the development.

3.1.11 Inclusion of living roofs and walls are technically feasible for the Proposed Development as referenced in the report. Their inclusion is not mandatory, but their feasibility for the site will need to be investigated in further detail at post-planning stage.

3.1.12 It has therefore been concluded that there is potential for a positive impact on the overall ecological value of the site and this will be qualified through the delivery of the BREEAM LE 1-5 criteria.

Transportation and Movement

3.1.13 The Proposed Development is located within ~3 minute safe walk of the nearest bust stop located on Goodge Street. This stop is served by 12 bus routes: (14, 24, 29, 73, 134, 390, N5, N20, N29, N73, N253, N279). In addition, the site is within ~300 metres safe walking distance of the Goodge Street Underground Station providing frequent underground services within London.

3.1.14 A Transport for London PTAL assessment has been carried out indicating that the location of the Proposed Development achieves PTAL rating of 6b, which represents outstanding access to public transport and the highest rating of accessibility.

3.1.15 The Proposed Development is also well served by local amenities with a food store, a restaurant, hotel, department store, and outdoor recreation space all located within a 1km radius.

3.1.16 As part of the Proposed Development, the use of alternative transport will be encouraged through the provision of safe, secure, indoor and outdoor cycle storage. The use of the cycling facilities and the local public transport networks will also be encouraged through the provision of relevant information and guidance to the building's occupants.

3.1.17 The site is also well served by cycle routes, with mostly on-road routes connecting the site to local amenities and services.

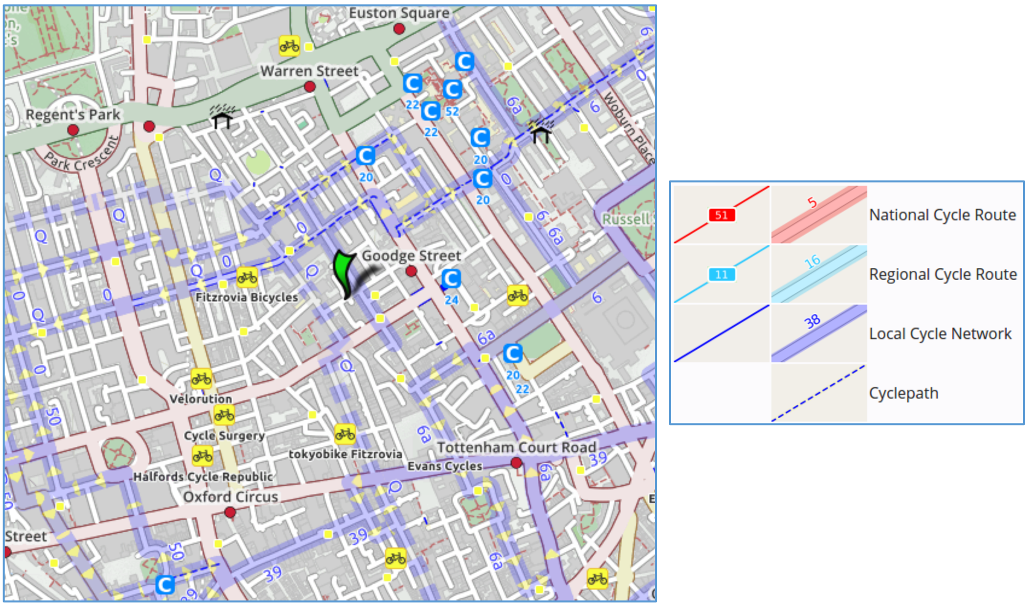


Figure 7: Nearby cycle routes and networks in relation to the site's location

3.1.18 The site is also adjacent to National Route 208, which links Raynes Park to Morden and provides a direct cycle route to Wimbledon train station as demonstrated in Figure 5 below.

3.1.19 The provision of cycle stores, and the sites close proximity to public transport facilities and amenities will aid in the promotion of sustainable transport choices by providing opportunities to walk and cycle.

3.1.20 A BREEAM compliant Transport Assessment and Travel Plan will need to be carried out and issued in support of planning.

3.2 Construction Processes

Construction Phase Waste Management

3.2.1 The Proposed Development will aim to minimise the waste produced from the site during the construction phase.

3.2.2 Poor specification of resources as part of the construction process can have a major environmental impact both in terms of the resources' manufacturing process, but also in terms of transport of the resources to site.

3.2.3 Surveys will be undertaken before significant work commences to ensure that the quantity of materials being delivered to site is correct and all materials, where possible are reused on site or segregated for recycling. A pre-refurbishment audit will also be undertaken in support of BREEAM and HQM. Ensuring the correct quantity of materials will ensure there is no wastage of materials on site, or excess pollution from surplus materials being returned to the supplier.

3.2.4 A comprehensive Resource Management Plan will be implemented from the outset of site works, following the principles of the waste hierarchy, with a target for 80% by volume (or 90% by tonnage) of the new build non-hazardous waste transported off site to be diverted from landfill. The pre-refurbishment audit conducted will be interred within the plan.

3.2.5 The construction waste generated as part of the redevelopment will be segregated and monitored as per best practice, with suitable materials being recycled as part of this process, either to be reused on site or introduced back into the supply chain through recycling by a Licensed Contractor, therefore minimising the amount of waste being disposed of in landfill sites.

3.2.6 Reusing materials on site will reduce the embodied energy of the development through the reuse of the energy that exists in that material. Transportation of new material to the site will be reduced, reducing the CO_2 emissions associated with transportation and material manufacture.

3.2.7 Where waste will need to be disposed of, this will be done in line with the Waste Hierarchy, with as much as practicable being recycled, and the remainder being dealt with through a specialist waste recycling contractor. Nominal construction waste should be sent to landfill or for incineration unless this is unavoidable due to the materials found on the existing site.

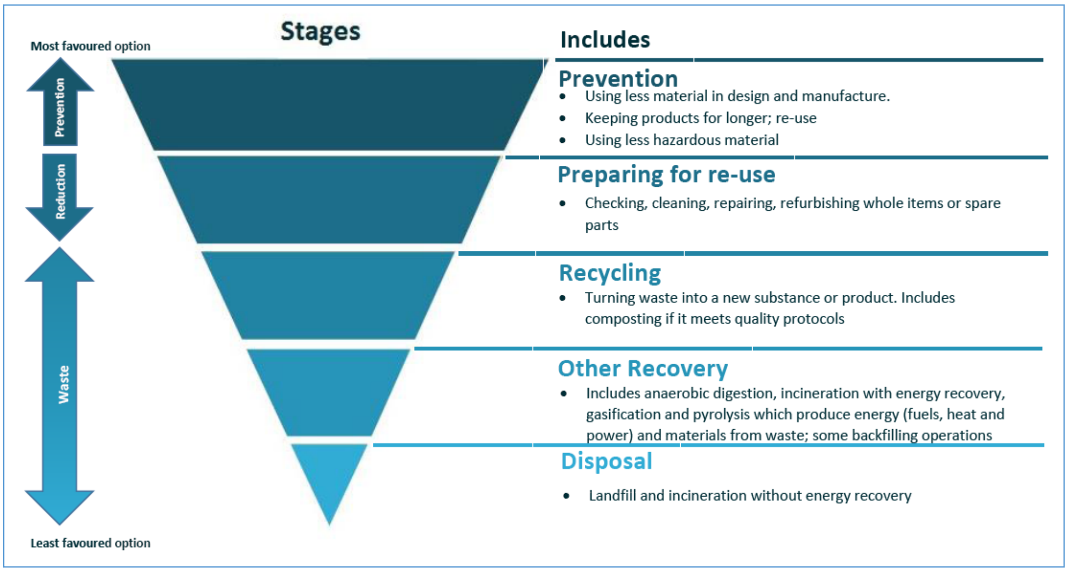


Figure 8: The Waste Hierarchy

3.2.8 The implementation of a Resource Management Plan will also be assessed as part of the BREEAM and HQM Wst 01 criteria.

Resource Management

3.2.9 Policies will be put in place for management of site impacts such as air and water pollution in line with industry best practice. Monitoring and reporting on carbon emissions and water use from site related activities will take place in line with national benchmarks.

3.2.10 The overall management of the construction waste will be monitored through the Considerate Constructors Scheme as part of Best Practice Site Management.

Considerate Constructors Scheme

3.2.11 The Considerate Constructors Scheme is a national, voluntary scheme, which is adopted by participating construction companies and everyone involved on the construction site. The scheme aims to assist and encourage contractors to carry out their operations in a safe and considerate manner, with due regard and causing minimum disturbance to local residents, businesses, passing pedestrians and road users.

3.2.12 As part of the overall management of the site, the main contractor will be encouraged to sign up to the Considerate Constructors Scheme[2] to ensure that high standards of construction are achieved. As per the BREEAM Man 01 criteria, a minimum score of 25 or above should be sought, with a minimum of 5 scored within each section. Targeting 35/50 will be sought.

3.2.13 The Scheme looks at the various aspects of construction work and sets appropriate standards in a number of categories relevant during the construction phase of a project, such as:

- Considerate
- Environment
- Cleanliness
- Good Neighbour
- Respectful
- Safe
- Responsible
- Accountable

3.3 Materials

3.3.1 The Proposed Development will use high quality, low impact materials. The form of construction for the scheme will be a concrete frame construction with brick cavity external walls, and all main structural elements of the construction will aim to achieve a Green Guide to Specification rating of A+ to D[3]. The BRE Green Guide to Specification assesses the environmental rating of materials against 11 weighted criteria, giving an overall grade from A+ to E.

3.3.2 Any materials used in a form of hard landscaping or boundary definition should also achieve a Green Guide rating of A/A+.

3.3.3 All timber is used on site will be legally sourced and certified and be from FSC and/or PEFC sources and all other materials sourced from suppliers who have an accredited Environmental Management System (EMS) (ISO14001, BS8555 or BES6001) for the extraction and process stages of the material manufacturing, ensuring that any environmental impact caused by the

2 http://www.considerateconstructorsscheme.org.uk
3 The Building Research Establishment – Green Guide to Specification 2008

building materials is analysed and mitigated where possible. Chain of custody certification will confirm this.

3.3.4 As standard industry best practice all insulation on the site will have an Ozone Depletion Potential (ODP) of zero, and a Global Warming Potential (GWP) of <5, further minimising the Proposed Developments effect on global Climate Change.

3.3.5 Specified materials will be assessed in detail as part of the BREEAM & HQM assessment for the Proposed Development, contributing to sections Mat 01 - Mat 04 of BREEAM.

3.4 Water

3.4.1 London has been declared an area of serious water stress. Water is a vital resource and efficient usage should be encouraged in all buildings. The Proposed Development aims to significantly reduce mains water use through a combination of efficiency measures.

Surface Water Run-off

3.4.2 In line with Camden Local Plan Policy CC3 the site will aim to minimise the risk of Surface Water Flooding.

3.4.3 The Proposed Development consists of the refurbishment of the existing commercial building and the added residential block at the rear of the property where there is presently hardstanding. In line with Policy CC3 Water and Flooding of the Camden Local Plan, developments are required to utilise Sustainable Drainage Systems (SuDs) in order to reduce the surface water discharge unless demonstrated that this is not feasible.

3.4.4 The use of appropriate attenuation techniques and soakaways will also be investigated as part of detailed design in order to reduce the overall flow and volume of surface water off the site. As a basement is proposed, it is unlikely that the onsite drainage will be achieved. It must be confirmed by a suitably qualified professional that flooding of the property will not occur in the event of local drainage system failure as per the Pol 03 criteria of the BREEAM Assessment.

Water Efficiency

3.4.5 Water efficiency will be managed in the Proposed Development through the use of fittings with a low capacity or flow restrictors. Where appropriate, aerating tap heads would also be fitted to taps to give the illusion of a higher flow of water.

3.4.6 The Proposed Development will reduce predicted potable water use for the commercial space to improve beyond the baseline performance by >50% under Wat 01 of the BREEAM Assessment through the following indicative specification:

- Kitchen sink taps to have a flow rate of 5 litres/min or less
- Hand-wash basin taps to have a flow rate of 3.75 litres/min or less
- WCs to have an effective flush volume of 2.95 litres or less (e.g. 4/2.6 litre dual flush)
- Showers to have a flow rate of 6 litres/min or less

3.4.7 Based on the BREEAM Water Efficiency Calculator, the specification listed will achieve a predicted water use of 17.61 litres per person per day.

3.4.8 For the Residential Block and in line with the Camden Local Plan Policy 8.56 to achieve water efficiency compliance of <110litres per head per day, water use for the residential units will be managed through the use of restricted flow rates on fittings. The Proposed Development will reduce predicted internal potable water use to <110 litres/person/day[4] in line with the Camden Local Plan standards through the following indicative specifications:

[4] As predicted through the BRE Water Efficiency Calculator Tool for New Dwellings

- Kitchen sink taps have a flow rate of 5 litres/min or less
- Bathroom basin taps have a flow rate of 4 litres/min or less
- Low Flow Showers (not more than 6 litres/min)
- Dual Flush WC's (4/2.6 Litre)
- Baths (160 litres capacity)
- Washing Machine (5.5 litres/kg dry load)
- Dishwasher (1.25 litres/place setting)

3.4.9 Summary Part G calculations are provided in Appendix B.

3.5 Pollution Impacts

3.5.1 Pollution from the construction and operational phases of the Proposed Development will be addressed in order to minimise negative effects on the environment from waste and resource usage.

3.5.2 An air quality assessment has been undertaken by Waterman Infrastructure & Environment Limited that explores the existing air quality at and surrounding the site, the proposed impact that the development may have on air quality, before recommending measures to mitigate the impacts.

Energy and CO_2 Emissions

3.5.3 The Proposed Development's predicted energy use, suitable energy efficiency measures, low carbon and renewable technologies and associated CO_2 emissions reductions are assessed in detail in Section 4.0. As per Policy CC1 from the Camden Local Plan and Policy 5.2 of the London Plan, the Proposed Development must make a full contribution in following the London energy hierarchy, achieve at least 19% improvement over Building Regulations 2013 Part L1A for the residential units and 35% improvement over Building Regulations 2013 Part L2A for the new commercial extension, as well as both areas providing a 20% carbon offset from renewables after energy efficiency measures have been accounted for. The Proposed Development will strive to achieve at least 8 credits under the Ene 01 section as part of the BREEAM assessment.

3.5.4 As mentioned within Paragraph 3.3.4, all insulation on the site will have a GWP of less than 5, and an ODP of Zero.

Light Pollution

3.5.5 Light Pollution will be minimised where possible through the careful specification and positioning of any external lighting around the Proposed Development, ensuring that no lighting negatively impacts on the surrounding residential and commercial units. Special attention should be given to security lighting (where fitted) to ensure it is appropriately focussed and controlled.

3.5.6 All external space lighting will be provided through low energy fittings, with security lighting being PIR and daylight and timer controlled. All relevant BREEAM methodology will be followed as stated under Pol 04 of the BREEAM assessment.

Operational Waste

3.5.7 The Proposed Development will have comprehensive recycling facilities where internal recycling bins are provided in accessible locations in order to facilitate waste recycling by the occupants of both the commercial and residential space.

3.5.8 As with many aspects of operational use within buildings, the performance is highly dependent on the users of the building. Therefore, information on the waste that can be recycled and the waste collections days will be provided to occupants as part of the Building User Guide, required for BREEAM and HQM.

Noise Pollution

3.5.9 Due to the type of activities on the site, it is not anticipated that the Proposed Development will produce noise of any significance above what would be associated with the previous use of the building and the surrounding area.

3.5.10 The Proposed Development will be fully compliant with Building Regulations Part E – Resistance to the passage of sound and acoustic (sound) testing will be performed on all intermediate wall and floor types by a suitably qualified professional. Improvements over Building Regulations will be sought for the residential units with ambient internal noise levels assessed in the commercial spaces.

3.5.11 The issue of noise pollution will also be considered in detail through the BREEAM & HQM assessment of the Proposed Development. A pre-programme report of recommendations to reduce environmental noise pollution has been completed by Sandy Brown Consultants.

3.6 Health and Wellbeing

Design Security

3.6.1 Based on previous, the Proposed Development will incorporate design considerations from an Architectural Liaison Officer (ALO) or Crime Prevention Development Officer, to ensure the development adopts security measures appropriate for the site.

3.6.2 All recommendations will be adopted into the final design, with an aim of achieving the Secured by Design: Section 2 award for residential units.

3.6.3 External (and communal internal) lighting will be of an energy efficient type with daylight cut-off switches and PIR sensors where appropriate. Security lighting will be PIR and Daylight controlled with a maximum output of 150 watts. Security lighting will be appropriately installed to prevent light pollution caused by inappropriately focussed or positioned lights.

Cooling Hierarchy

3.6.4 The Proposed Development has significant amount of glazing on the south east facing facade, and therefore has significant potential for positive solar gains, but could experience overheating during periods of excessive summer temperatures if sustainable measures are not put in place.

3.6.5 The London Plan Policy 5.9 sets out a cooling hierarchy of design measures that will reduce potential overheating and reliance on air conditioning systems especially for residential units. Table 3 below sets out the design measures in relation to the Proposed Development.

London Plan Cooling Hierarchy	Potential Design Measures
Minimising internal heat generation through energy efficient design	Limiting amount of pipework and heat losses through good design and mechanical risers in central locations
Reducing the amount of heat entering the building in summer	All units could have internal blinds, although currently the design does not have them incorporated
Use of thermal mass and high ceilings to manage the heat within the building	The building will comprise of a traditional construction in order to allow for medium-high thermal mass to reduce overheating risks.
Passive Ventilation	The majority of windows will be openable in order to allow natural ventilation with all offices and houses benefiting from effective cross-ventilation.
Mechanical Ventilation	Standard extract fans from wet rooms only have been proposed at this stage due to sufficient potential for natural ventilation and in order to reduce overall energy use and CO_2 emissions.

Table 3: London Plan Cooling Hierarchy

3.6.6 Robust levels of insulation will help reduce heat exiting and entering the buildings. As the main building will be made up of an existing concrete frame and brick infill with an additional new concrete frame structure, there will be good thermal mass in the main fabric and structure of the building. This will help reduce the potential risk of overheating in the summer months by absorbing solar radiation and allowing it to dissipate without being transmitted into the building itself. There will be a high amount of solar gains on the commercial building due to the significant amount of glazing on the south-east facade. Therefore, low-E solar glazing and internal blinds/ shutters may be used in both the commercial and residential units at post-planning stage in order to reduce the risk of overheating.

3.6.7 An outline overheating assessment following the London Plan overheating criteria (as per Table 4) has been undertaken on the offices using IES modelling in order to determine if they require an active cooling system. The residential units have not been analysed in detail due to nominal amount on glazing on the south west facing façade, a predominant percentage of which will be shaded by the commercial block and supported by the SAP outputs.

Criterion	Definition
1	The maximum number of hours that the operative temperature can exceed the threshold comfort temperature by 1°K or more during the occupied hours of a typical non-heating season (1st May to 30th September) should be no more than 3%
2	A daily limit of acceptability for the severity of overheating within any one day based on both temperature rise and its duration
3	An absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable

Table 4: Overheating Criteria London Plan

Unit	Criterion 1 Compliance	Criterion 2 Compliance	Criterion 3 Compliance	SBEM Compliance	Overall Overheating Risk
Offices	-	-	-	✓	NO

Table 5: Overheating Analysis Offices Arthur Stanley House

3.6.8 At present, an active cooling system is proposed for the offices, as based on the SBEM modelling undertaken they do not achieve compliance with the overheating criteria. The proposed cooling requirements will be less than the notional cooling requirements, which is supported by the SBEM outputs in Appendix C.

3.6.9 Detailed overheating analysis may be undertaken at post-planning stage in order to support both ongoing design work and BREEAM.

4.0 Energy Assessment

4.1 Energy Approach

4.1.1 The outline approach for the Proposed Development in addressing energy issues, and responding to the planning policies and guidance, is through minimising the building's overall environmental impact and reducing its resource use to exceed the performance standards required by Building Regulations.

4.1.2 The approach adopts the following standard energy strategy (in-line with general national energy policy) by seeking to:

- Use Less Energy (Be Lean) – minimise the overall environmental impact and energy use through energy efficiency measures - e.g. improved insulation and glazing.
- Use Clean Energy (Be Clean) – ensure that energy systems on-site (heat and power) are efficient and produce minimal CO_2 emissions - e.g. high efficiency boilers/heat pumps
- Use Renewable Energy (Be Green) – implement the use of suitable technologies to provide renewable and emission free energy sources.

4.1.3 The design has sought to greatly enhance the existing and new building envelope specification to minimise the overall energy demand and to implement good passive solar design where practicable.

4.1.4 The CO_2 Conversion Factors have been taken from Building Regulations 2013:

	CO_2 Conversion Factor ($kgCO_2/kWh$)
Electricity (mains)	0.519
Electricity (offset)	-0.519
Gas (mains)	0.216
Heating Oil	0.298
Wood Pellets	0.039
Woodchip	0.016

Table 6: CO_2 Conversion Factors

4.1.5 Carbon Dioxide (CO_2) is the main greenhouse gas[5] that is deemed responsible for anthropogenic climate change[6]. Although by mass it does not have as high radiative forcing effect as other gases (namely CH_4 – Methane), the sheer quantity released through combustion means that, overall, it has the most effect. It is also one of the more controllable – it can be directly controlled through reductions in fossil energy use.

4.2 Baseline Energy Prediction

4.2.1 The overall energy strategy for the Proposed Development, will be to use less energy, use clean energy and use renewable energy and to design an energy conscious building to positively influence the overall predicted energy demand.

4.2.2 The notional energy prediction for the Proposed Development uses the exact size and shape of the Proposed Development, but is based on notional U-values and heating specifications as per the Building Regulations 2013. The notional model defines the Target Emissions Rate (TER)

[5] Joint Science Academies' statement, 2005: Global response to climate change

[6] IPCC, 2007: Summary for Policymakers & Technical Summary. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*

for both the residential and commercial buildings and the Target Fabric Energy Efficiency (TFEE) for the dwellings.

4.2.3 Building Regulations 2013 Part L defines the TER through the following formula:

$$TER_{2013} = C_H \times FF + C_{PF} + C_L$$

Figure 9: Building Regulations 2013 Part L TER calculation

4.2.1 In calculating the TER, a fuel factor is applied to the provision of space heating and hot water C_H), which is then added to the energy use of pumps and fans (C_{PF}) and the internal lighting load (C_L). Therefore depending on the fuel source providing the heating and hot water for the Proposed Development, the target requirements will vary.

4.2.2 Energy modelling for the Proposed Development has been undertaken based on SAP 2012 (residential), SBEM v.5.2.g.3 (commercial) and in accordance with Building Regulations 2013. This modelling has been used to generate the energy baseline, which will provide an indication of the energy and CO_2 target emissions criteria that the Proposed Development will need to meet in order to achieve Building Regulations 2013 Part L compliance. The baseline specifications follow the London Plan guidance, in which heating is provided via gas boilers and active cooling (where present) would be provided by electrically powered equipment.

Unit Type	Energy Baseline (tonnesCO_2/ yr)	Target Fabric Energy Efficiency (TFEE) ($kWh/m^2/yr$)
Commercial	31.35	n/a
Residential	14.20	14.32

Table 7: Arthur Stanley House Energy Baseline

4.2.3 It has to be noted that due to the different methodology of calculating the TER and the energy baseline for residential units, when heat pumps are used to provide space heating, improvement results may vary when comparing the Dwelling Emissions Rate (DER) to the aforementioned two criteria. The DER/TER improvement will be higher than the DER/energy baseline improvement due to the fuel factor applied, as described in paragraph 4.2.1. For the purpose of this assessment, the energy baseline results have been used throughout in accordance with the London Plan criteria.

4.3 Energy Conservation Measures (be lean)

4.3.1 A number of energy conservation measures will be incorporated by the Client in-line with both the Policies detailed in Section 2 as well as general national 'Best Practice' guidance for delivering energy efficient buildings.

Passive Solar Design

4.3.2 The Proposed Development location and orientation have been determined by the existing building and site layout. Where possible the redevelopment and new elements have been designed to maximise opportunities for solar gain, whilst also considering the possible risk of overheating. Overheating can result from excessive solar gain combined with an airtight building with a high standard of fabric efficiency. If and where appropriate, solar gain via glazing will be controlled using appropriate glass (Low E) and internal blinds.

Insulation and Air Tightness

4.3.3 All new build elements will incorporate high performance insulation in the building envelope (walls, roofs and floors) to ensure that the space heating load will be reduced. Existing elements will be upgraded, for example, with the addition of external insulation and cladding.

4.3.4 The proposed U-values for the buildings have been calculated based on the current building specification as follows:

Element	Proposed U-Values
Roof	0.15
External Wall (new)	0.15
External Wall (existing)	0.15
Ground Floor	0.15
Internal Floors above unheated spaces (residential)	0.15
Windows (commercial and residential)	1.11 (g-value of 0.24)
Doors (commercial)	2.2

Table 8: Proposed U-values

4.3.5 Air tightness has been estimated as achieving a rate of ~4m^3/hr/m^2 or lower in the residential units and ~5m^3/hr/m^2 in the commercial space. This will be tested as part of Building Regulation compliance and to inform final As-Built SAP and SBEM calculations at post-construction stage.

Thermal Bridging

4.3.6 Thermal bridging is the process by which materials that directly connect the internal and external walls of a building (e.g. lintels and wall ties) transfer warmth out of the buildings through conduction. Thermal bridges occur where there are gaps or discontinuation of the insulation material. They are measured in W/mK and represent the additional heat loss from a point or element compared to the adjacent surfaces. Figure 10 below represents constructions where thermal bridging has not been taken into account, therefore there are increased heat losses through those details.

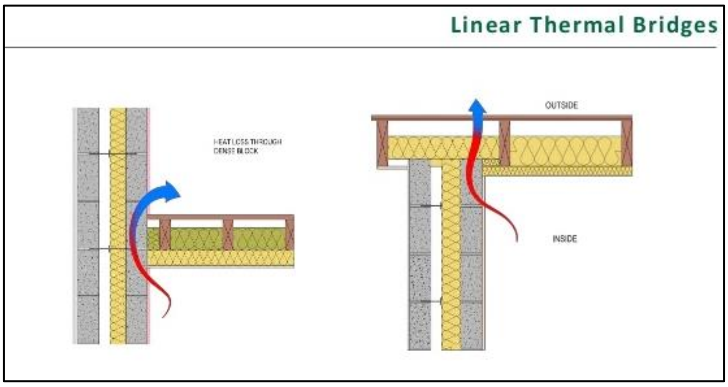


Figure 10: Thermal bridge representation (Source: Quinn Building Products)

4.3.7 Through careful selection of materials and construction techniques and attention to detail around materials junctions, it is possible to reduce the level of thermal bridging apparent within the buildings, in turn, reducing the heat losses.

4.3.8 Accredited Construction Details are proposed for all thermal bridges and IG-Hi Therm lintels for the residential units at the Proposed Development in order to comply with the requirements of the latest Building Regulations and reduce the space heating requirements.

Energy Efficient Lighting and Appliances

4.3.9 The Proposed Development will make use of low energy lighting in-line with BRE methodology and in excess of Building Regulation requirements.

4.3.10 Although appropriate appliances are expected not to be fitted as part of the development, advice will be provided to the occupants detailing the benefits of energy efficient appliances. Based on the BRE calculation methodology these measures will reduce electrical demand by around 10% - although it is not possible to quantify any reductions at this stage or through the SBEM calculations.

4.3.11 The buildings will ensure that any external lighting is positioned, controlled and focused to provide efficient safe and secure access without using excessive energy. This will comprise energy efficient luminaires or in the case of any specified security lighting, a maximum lamp capacity of 150W per fitting, supported by infrared, sensor and time controls as standard.

4.3.12 The residential units will utilise 100% low energy efficient lighting, whilst the commercial areas will look to utilise high quality LED lighting, ensuring compliance with the appropriate Building Regulations 2013 Part L and BREEAM criteria.

Ventilation

4.3.13 In modern air-tight buildings, careful consideration needs to be given to the specification of ventilation systems to ensure moisture is removed and ventilation standards are met.

4.3.14 At present, it has been assumed that the building will be comprised of a concrete frame construction with brick cavity external walls and will have openable windows that will allow cross-ventilation to occur where possible. Mechanical Ventilation Heat Recovery (MVHR) is planned within the residential units extracting warm, moist air from the kitchens and wet rooms, before using the heat to warm the fresh air being supplied to the bedrooms and living areas. Standard mechanical extract fans have been proposed for the WCs within the commercial spaces.

Influence Energy Behaviour

4.3.15 The Proposed Development, both residential and commercial spaces, will be provided with a Building User Guide which will detail how to effectively use all the appliances and fittings installed and thereby minimise associated energy use and CO_2 emissions. This information will inform the occupants on how to gain maximum benefit from the appliances and energy systems provided and will help to positively influence their long-term energy behaviour.

4.3.16 Smart Meters monitor energy consumption within individual units and display real time consumption and cost data, avoiding the need for estimated billing and meter reading visits. They can monitor both gas and electricity consumption and enable occupants to manage their energy use more efficiently. The residential block will be supplied with Smart Meters (where available from the utility supplier).

4.3.17 The commercial premises will have separate metering for all major loads and per floor plate, which will contain 'out-of-range' values, and must cover at least heating, hot water, cooling and ventilation loads as part of the BREEAM assessment.

4.3.18 All major utilities now offer a 'green energy tariff' to business and domestic customers from either their own renewable sources (such as offshore wind farms) or are purchasing power from such sources for their green energy tariff. Although this does not qualify as a renewable energy technology, it is recommended that the Proposed Development be connected to a green electricity tariff as standard.

Unit Type	'Be Lean' (tonnesCO_2/ yr)	Savings over baseline	Dwelling Fabric Energy Efficiency (DFEE) (kWh/m^2/yr)
Commercial New	26.16	16.55%	n/a
Commercial Existing	46.01	26.11%	n/a
Residential	13.99	1.51%	63.40

Table 9: 'Be Lean' Arthur Stanley House

4.3.19 As a result of the 'be lean' measures outlined above, the Proposed Development is able to reduce the regulated CO_2 emissions by 16.55% for the new commercial areas, 26.11% for the existing commercial areas and 1.51% for the dwellings when compared to the energy baseline.

4.4 Energy Supply (be clean)

4.4.1 Through the use of on-site generation powered by fossil fuels (low carbon technologies) the Proposed Development can potentially achieve CO_2 savings.

4.4.2 Table 10 summarises the various 'clean energy' solutions that have been assessed for the Proposed Development and their feasibility.

Technology	Technically Feasible	Regulated CO_2 offset	Benefits	Weaknesses
District heating	✓	✓	Allows a mix of fuel sources to be utilised. Reduces space required in individual units for boilers and cylinders.	No existing networks within the immediate area.
Combined Heat & Power	✓	✓	Electrical generation alongside heat production.	Gas dependant. Only effective if space heating demand is sufficient for micro generation within each unit.
Communal gas fired boiler system	✓	×	Low NO_x emissions. Responsive system.	Low CO_2 offset.
Individual gas fired boiler system	✓	×	Low NO_x emissions. Responsive system.	Low CO_2 offset.

Table 10: Summary of 'Clean' Energy Provision

District Heat Networks

4.4.3 An initial scoping assessment of local decentralised heat and power options has been undertaken using the London Heat Map and there are no existing heat networks in the local area that the scheme could be connected to (yellow lines). However, Figure 11 shows the site's relative proximity to the proposed future network on Euston Road.

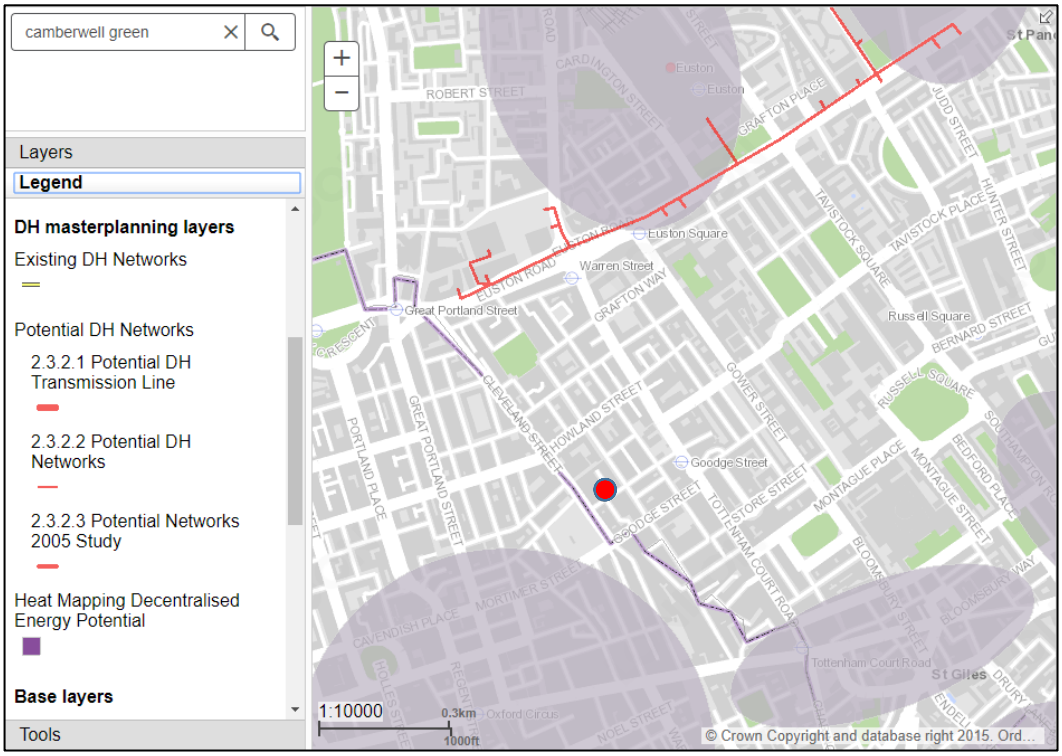


Figure 11: London Heat Map showing the nearby location of the proposed District Heating Network (Red Line) servicing Euston Road and the nearby stations in relation to Arthur Stanley House (Red circle)

4.4.4 At present the provision of a new district heating network is highly unlikely to be granted based on the site's size and distance from any existing networks. However, there remains the potential for a linkup to be installed in the future if/and when the Euston Road network is installed. The purple polygons in Figure 11 show areas where decentralised energy has been cited as potentially worthwhile. The site's proximity to two of these areas, whilst also being ~500m from a proposed network could mean that a future link-up may be possible. Therefore it has been proposed that a 'soft point' connection be installed in the plant room of the commercial building of Arthur Stanley House and residential block to future proof the buildings.

Combined Heat and Power (CHP)

4.4.5 The use of CHP has been considered in outline as a possible heating system, with the added benefit of on-site electrical generation. Further assessment of the heating loads and seasonal cycles would need to be completed at detailed design stage prior to any inclusion.

4.4.6 A CHP system can be an efficient way of generating electricity on-site with the benefit of reduced fuel costs (gas being cheaper than electricity) and reduced carbon emissions. Heat generated from the gas engine is used to produce hot water or steam for heating and domestic hot water.

4.4.7 With regards to the residential building, a separate micro/small scale communal CHP system with a backup commercial boiler (91% efficient) with a heating ratio of 50:50 would prove technically feasible but need to be managed and operated by the building operators. However for the commercial building, the low hot water demand and mix of heating and cooling provision will be more effectively addressed using heat pump solutions, so has been deemed technically unfeasible. Table 11 below shows the results from modelling the installation of such a system in the residential block.

Unit Type	'Be Lean and Be Clean' (tonnesCO_2/yr)	Savings from CHP
Residential	11.14	20.35%

Table 11: Improvements over the baseline as a result of 'lean' elements and the installation of CHP

4.4.8 Another consideration is the provision of adequate space internally or externally for two plant rooms. The bottom floors of the subterranean levels of each block have been deemed to be feasible locations for centralised plants as shown on the architect's planning drawings.

4.4.9 Should CHP be chosen to provide the space and water heating for the residential building, a micro unit would be proposed for the residential unit.

Active Cooling

4.4.10 Active Cooling is to be installed as means of providing comfort cooling and ensuring the buildings do not overheat. Each of the residential units in the form of a small AC unit with an Energy Efficiency Rating (EER) of 4.6, which can be controlled at variable speeds.

4.5 Renewable Energy Assessment (be green)

4.5.1 Table 12 summarises the various renewable energy solutions that have been assessed for the Proposed Development. These technologies will be compared alongside the proposed high efficiency gas boilers system.

Technology	Technically Feasible	Regulated CO_2 offset	Benefits	Weaknesses
Ground Source Heat Pumps	×	×	Provides space heating and a proportion of domestic hot water independent of gas.	Low overall CO_2 offset. 2.5x the area of each unit needed. Ground conditions dependant, borehole drilling costs.
Air Source Heat Pumps	✓	×	Provides space heating and a proportion of domestic hot water independent of gas.	Low overall CO_2 offset. Potential system noise. Low Carbon Solution
Biomass Boiler	×	✓	Low CO_2 emissions.	Fuel storage space, cost and security of supply. High NO_x emissions. Air quality implications.
Photovoltaics	✓	✓	High CO_2 offset and proven technology.	Susceptible to shading.
Solar Water Heating	×	✓	Efficient and integrates with a domestic heat pump or boiler.	Lower CO_2 offset as replacing gas supply. Susceptible to shading.
Wind Turbines	×	✓	Strong visual impact.	Poor output for turbine of a size likely to be accepted by planning authority

Table 12: Summary of Renewable Energy Assessment

The use of Heat Pump Technology

4.5.2 The use of heat pumps (HP) in place of a gas heating system can be feasible in terms of CO_2 emissions, but only if the system is well sized and ground conditions (for GSHPs) are such that a high Co-efficient of Performance (CoP) can be achieved on average.

4.5.3 Heat pumps will only deliver low grade heat (~50°C) efficiently, and therefore HP systems are generally relatively inefficient in providing Domestic Hot Water (DHW), as this requires additional electrical use (immersion or increased compressor use), unless a treated hot water system is used, or hot water provided via a separate system.

4.5.4 There is also the issue of 'future-proofing' a building – gas is a finite resource which is decreasing in availability and therefore increasing in cost. To maintain energy security it may be wise to ensure that, even if a building is specified with a gas system, there is the capability to move it to a heat pump based system at a later date, especially as the CO_2 emissions associated with electrical generation diminish through the wider use of renewable technologies.

4.5.5 It is possible to use a heat pump for the heating supply and a separate gas boiler for hot water demand. This maximises the performance of both technologies and minimises their environmental impact but results in significant capital cost and scores poorly in SAP calculations (due to the way SAP assesses mixed electric/gas systems).

Air Source Heat Pumps

4.5.6 The use of Air Source Heat Pumps (ASHP) has the potential to supply the Proposed Development with their heating and possibly hot water requirements, subject to the provision of oversized/low temperature radiators (air-to-water systems).

4.5.7 As with all Heat Pump systems ASHP systems consume electricity in order to operate - the Coefficient of Performance of the system is the ratio of electrical energy consumed, to heat energy emitted.

4.5.8 This is affected by a number of factors, including system design, outside air temperatures (solar irradiation) and patterns of use.

4.5.9 ASHPs tend to generate a lot of noise and therefore the space in which the pump is positioned would need to be adequately sound insulated in order to prevent disturbances to the building's occupants.

4.5.10 The only suitable location for the installation of a communal ASHP system for the commercial space of the Proposed Development is on the roof area. Due to the lack of available space and the noise generated from individual units, it has been deemed feasible for use on the residential units providing there is adequate sound insulation.

Unit Type	'Be Lean', CHP and backup ASHP (tonnesCO_2/yr)	Savings from CHP & ASHP
Residential	11.62	16.96%

Table 13: Improvements over the baseline as a result of implementing the 'be lean' solutions alongside a CHP system and backup ASHP

4.5.11 Table 13 shows the improvements over the baseline by using a CHP system with backup ASHP. The annual savings have been reduced as a result of the any electricity produced by the CHP being negated and consumed by the ASHP. Therefore it has deduced that using a backup ASHP is not a viable solution.

Variable Refrigerant Flow (VRF)/ Variable Refrigerant Volume (VRV)

4.5.12 A VRF/VRV system could potentially be installed at the Proposed Development, which would be suitable for all commercial areas. In order to make best use of a VRF/VRV system, small areas within the buildings or areas which could require a minimal amount of heating would be serviced by convection heaters. This would include areas such as communal hallways or toilets.

4.5.13 VRF/VRV systems allows the temperature of each individual space to be individually heated or cooled, providing a high level of user comfort, with relatively simple methods of control. Because of this, if used properly, a VRF system has potential to save energy as it can be used as required simultaneously within multiple spaces in a building.

4.5.14 Similar to an ASHP, a VRF/VRV system measures its energy efficiency as a Coefficient of Performance and Energy Efficiency Ratio. It is proposed that a SCoP of >4.5 and an SEER of >6 (SSEER of >5) are targeted in order to ensure efficient use of resources. In order to improve upon this, a specialist installer would need to be consulted for sizing and specification.

Unit Type	VRF 'Be Lean, Clean and Green' (tonnesCO_2/yr)	Savings from VRF
Commercial New	23.46	10.34%
Commercial Existing	38.07	17.24%

Table 14: VRF Performance on the commercial block

4.5.15 As per Table 14, the performance of a VRF gives significant savings in addition to the 'be lean' measures. As a CHP system cannot provide the required heating load to supply the building, and gas boilers still include the use of natural gas, a finite resort, it has been established that VRF will be used for the commercial building.

Ground Source Heat Pump

4.5.16 The use of a Ground Source Heat Pump would have the potential to supply the Proposed Development with a proportion of its space heating and hot water requirements subject to the provision of under floor heating (wet system) to maximise the GSHP system performance.

4.5.17 As the majority of the commercial space is the refurbishment of an existing building and there is limited ground available under the extension, it is not feasible to install a GSHP to serve this part of the development.

4.5.18 A GSHP usually requires an area that is 2.5x greater than that of the property it is aiming to heat. Bearing in mind the total area of the 9 residential units is ~638m^2, this would require an area of ~1595m^2 to be able to adequately service the dwellings.

4.5.19 Due to negligible external areas for a ground loop installation, and the cost and complexities of borehole drilling, the use of GSHP is not considered economically feasible or practical for the scheme.

4.5.20 In addition where compared to a gas baseline, a heat pump solution is unlikely to offer any substantial CO_2 savings over a gas fired heating solution.

Biomass Boiler

4.5.21 The use of a biomass boiler system to supply hot water and space heating has been deemed unpractical due to the complications in providing the regular fuel supply of pellets/chip to the site to power a site of this scale. The London Borough of Camden is designated a Smoke Control Area and therefore a biomass boiler is restricted from being used in this area.

Photovoltaics

4.5.22 The installation of Photovoltaics (PV) could be used to offset electrical demand within the Proposed Development. The Photovoltaic array would be connected into the electrical system via an inverter or series of inverters, depending on system size and setup.

4.5.23 Noise will not be an issue – A PV system does not feature moving parts and is silent during operation.

4.5.24 Both the residential and commercial buildings feature flat roofs, therefore a PV mount system is appropriate which would be installed onto frames at an inclination of 5-15° (depending on warranty specifications) and provide a stable and secure structure for the array.

4.5.25 For the purposes of the study, a 275W monocrystalline module will be used as an example of a standard module. An alternative module using triple junction technology requires a greater area per kWp with an equivalent 150W panel has not been proposed. Each PV panel covers an area of ~1.7m^2 (1.6m x 1m) and has a peak output of 275W. The Proposed Development will need to install a PV array in order to address Planning Policies, but the occupiers will have a direct benefit should they decide to apply for the Feed-in Tariff scheme.

4.5.26 As per policy CC1, an indicative outline assessment has been carried out in order to determine the maximum amount of PV that could be installed at the Proposed Development.

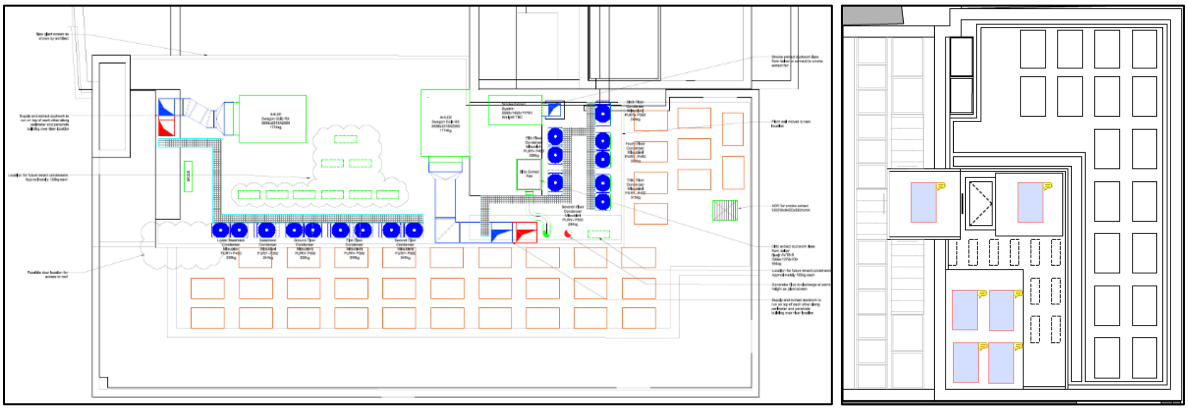


Figure 12: The potential PV layout on both the commercial (left) building and residential (right)

4.5.27 The residential block is shaded from most angles, primarily by the commercial space to the south-east and therefore the performance of any PV installed will be hindered by lower light levels.

4.5.28 The commercial space benefits from being a tall building and therefore is able to maximise daylighting opportunities on the upper storeys. Any PV on the roof of this building would achieve its maximum potential by placing a larger number of panels facing east, than to install a fewer number facing south and possibly inhibiting shading from the elevated towers on the roof.

4.5.29 The indicative assessment demonstrates that the maximum PV that could be fitted on the flat roof of the residential block and commercial building is 6.6 kWp (based on 24x275W) and 10.53 kWp of PV respectively (this includes a nominal provision of space required for plant room/risers or other M&E services).

4.5.30 A detailed assessment conducted by a manufacturer or installer must be undertaken at post-planning stage in order to set out the optimal design for the PV installation based on the available roof area and confirm the findings of this report. Table 15 below analyses the performance of the PV system and predicted output, based on south facing PV panels on the roof of the commercial space and east facing PV panels on the residential block at an inclination of 15-30°. Table 15 also demonstrates the improvement over the baseline in combination with the proposed solution.

PV Split	Electricity generation (kWh/annum)	Addition of PV (tonnesCO_2/ yr)	Savings from PV
Commercial 10.53 kWp	7,734	31.67	18.27%
Residential 6.6 kWp	3,835	9.15	17.85%

Table 15: PV performance Arthur Stanley House

Solar Water Heating

4.5.31 The installation of Solar Water Heating (SWH) could be used to offset a proportion of the domestic hot water demand (DHW), subject to the installation of an appropriate hot water cylinder (dual coil) and space allowed within the design for the required insulated flow and return pipework.

4.5.32 Noise will not be an issue with SWH – the only moving part is the circulation pump, which is inside the property and should not be noticeable.

4.5.33 Unlike PV, where the overall performance is generally limited by available roof space and finances, the CO_2 offset achievable with SWH is limited by the occupancy and estimated hot water load of the unit – too large a system can overheat an individual hot water tank at peak solar insolation.

4.5.34 Due to the nominal demand of hot water in the commercial premises, and the insufficient roof area for installation on the roofs of buildings in addition to PV, this system is deemed as technically unfeasible and unpractical.

Wind Power

4.5.35 Due to the location and nature of the site, it is not likely to lend itself to the use of wind turbines.

4.5.36 There is no suitable area for the installation of either a horizontal or vertical wind turbine. Air flow within cities is often turbulent due to the number and varying heights of other buildings which would reduce the efficiency of any turbine installed. Finally, an active turbine may also cause the building to vibrate, or otherwise structurally damage the building due to its contact motion, therefore by taking these factors into consideration, it has been deemed technically unfeasible to install a wind turbine at the Proposed Development.

4.6 Energy Summary

4.6.1 Table 16 lays out the various energy strategies that have been proposed for both the existing and new commercial block and the residential building, encompassing the following savings:

Unit Type and Solution	Proposed Strategy Impact (tonnesCO_2/yr)	Savings from Proposed Strategy
Residential – ‘Be lean’, CHP and PV	9.15	35.56%
Commercial New – ‘Be lean’, VRF and PV	9.04	35.75%
Commercial Existing – ‘Be lean’ and VRF,	38.07	38.85%

Table 16: The proposed energy strategy, its impact and savings on the baseline model for each block of the development

4.6.2 The 35% savings required from the London Plan has been exceeded by both the Residential and new commercial block through the implementation

5.0 Life Cycle Cost Analysis – Simple Payback

5.1 *Commercial* – Construction

5.1.1 The installation of VRF and Solar PV does not incur high costs when incorporated into the construction phase of the development. While both require 'specialist installers' in the form of qualified plumbers and solar installers, there are a large number of companies who can supply these services in the Greater London area, ensuring that prices remain competitive.

Operation

5.1.2 VRF Systems and Solar PV both have relatively low operational costs. The costs included in this section are: utilities, cleaning and management costs.

5.1.3 Future prices for utilities are extremely difficult to predict, especially over a long period of time such as 60 years. It would not be unreasonable to assume that due to decreasing global fossil fuel reserves, the cost of gas could increase exponentially over the lifespan of the Proposed Development.

5.1.4 However, for the purposes of this study, the real and discounted costs of the utilities have been calculated using the trends seen over the past 10 years since 2007, which have been extended to the year 2076. Although energy prices are never linear, this should give a conservative but fair estimation of the potential future unit costs.

5.1.5 VRF systems require minimal cleaning of the air filters, additionally Solar PV panels situated beyond 15 degrees are self-cleaned by rain. The costs of cleaning the energy system should be negligible over the life of the system.

5.1.6 VRF systems require no management as automatic room thermostats can be set to maintain a constant temperature. Additionally, modern systems have a user-friendly interface, making it easy for members of staff with no training to quickly adjust the settings if desired.

5.1.7 Solar PV also requires no management once they have been installed. The only requirement would be to check the levels of energy production on a clear, fine day to ensure that the expected production is being achieved. This could be carried out routinely by a member of staff to avoid additional management costs.

Maintenance

5.1.8 This section includes the costs related to: planned maintenance, replacements and repairs.

5.1.9 VRF Systems require minimal maintenance and PV panels require next to none once installed. An annual VRF service cost depends on the size of the system but due to advanced technology, they have a low margin of error. PV panels do not require servicing or maintenance. Maintenance costs are therefore negligible.

5.1.10 A VRF system should have a life span of around 20 years depending on its use and quality of maintenance.

5.1.11 According to the Energy Saving Trust, the standard estimated lifespan of PV panels is 25 years. Inverters will also need replacing during this period.

5.1.12 Given that the PV is external and that issues may arise with the VRF, the sum equivalent to 20% of the total capital costs has been allocated for repairs to the systems during the lifetime of the building.

5.1.13 Calculations assume a rate of inflation of 2.3% and UK interest rate of 0.25%.

5.1.14 Payback is assumed as costs saved on electricity due to self-generation from PV and VRF. Electricity is assumed at a cost of 14.9p per kWp in 2017.

	60 year Cost		60 year Savings	
	Real	Discounted	Real	Discounted
Construction				
Capital costs	£ 9,345	£ 9,345		
Installation	£ 4,106	£ 4,106		
Sub-total	**£ 13,451**	**£ 13,451**		
Operation				
Gas Utility	£ -	£ -		
Electric Utility	£ 792,587	£ 792,587		
Electric Generation			£ 117,226	£ 117,226
Cleaning	Negligible			
Management	Negligible			
Sub-total	**£ 792,587**	**£ 792,587**	**£ 117,226**	**£ 117,226**
Maintanance				
Planned Maintanance	Negligible			
Replacements	£ 33,421	£ 33,338		
Repairs	£ 6,684	£ 6,668		
Sub-total	**£ 40,105**	**£ 40,005**		
	Real	**Discounted**		
Total	**£ 728,917**	**£ 728,817**		

Figure 13: Life Cycle Costing for the VRF and PV solution on the commercial block

5.2 *Residential* – Construction

5.2.1 Similar to the commercial installation fees, the installation of CHP does not incur high costs when incorporated into the construction phase of the development. While both require 'specialist installers' in the form of qualified plumbers and solar installers, there are a large number of companies who can supply these services in the Greater London area, ensuring that prices remain competitive.

Operation

5.2.2 Solar PV and CHP both have relatively low operational costs. The costs included in this section are: utilities, cleaning and management costs.

5.2.3 Future prices for utilities are extremely difficult to predict, especially over a long period of time such as 60 years. It would not be unreasonable to assume that due to decreasing global fossil fuel reserves, the cost of gas could increase exponentially over the lifespan of the Proposed Development.

5.2.4 However, for the purposes of this study, the real and discounted costs of the utilities have been calculated using the trends seen over the past 10 years since 2007, which have been extended to the year 2076. Although energy prices are never linear, this should give a conservative but fair estimation of the potential future unit costs.

5.2.5 VRF systems require minimal cleaning of the air filters, additionally Solar PV panels situated beyond 15 degrees are self-cleaned by rain. The costs of cleaning the energy system should be negligible over the life of the system.

5.2.6 VRF systems require no management as automatic room thermostats can be set to maintain a constant temperature. Additionally, modern systems have a user-friendly interface, making it easy for members of staff with no training to quickly adjust the settings if desired.

Maintenance

5.2.7 This section includes the costs related to: planned maintenance, replacements and repairs.

5.2.8 SAV CHP systems require maintenance around every 10,000 operating hours or roughly every two years. This service mainly consists of changing the oil, filters and spark plugs and costs £1,460. With a life span of around 15 years, this would require around 7 services throughout its operation.

5.2.9 As with the commercial space, the sum equivalent of 20% of the total capital costs has been allocated for repairs to the systems during the lifetime of the building. Payback has also been assumed again as the costs saved on electricity due to self-generation from PV and CHP.

5.2.10 Calculations assume a rate of inflation of 2.3% and UK interest rate of 0.25%.

	60 year Cost		60 year Savings	
	Real	**Discounted**	**Real**	**Discounted**
Construction				
Capital costs	£ 8,290	£ 8,290		
Installation	£ 3,320	£ 3,320		
Sub-total	**£ 11,610**	**£ 11,610**		
Operation				
Gas Utility	£ 316,898	£ 316,115		
Electric Utility	£ 72,303	£ 72,303		
Electric Generation			£ 146,023	£ 146,023
Cleaning	Negligible			
Management	Negligible			
Sub-total	**£ 389,201**	**£ 388,418**	**£ 146,023**	**£ 146,023**
Maintanance				
Planned Maintanance	Negligible			
Replacements	£ 45,616	£ 45,502		
Repairs	£ 9,123	£ 9,100		
Sub-total	**£ 54,739**	**£ 54,602**		
	Real	**Discounted**		
Total	**£ 309,527**	**£ 308,608**		

Figure 14: Life Cycle Costing for the CHP and PV solution on the residential block

6.0 Summary

6.0.1 The Proposed Development at Arthur Stanley House, London will comprise of a Basement, Lower Ground, Ground and Seven upper storeys of commercial space with a reception area and nine new residential dwellings spread over a Lower Ground, Ground and three upper storeys.

6.0.2 The Proposed Development will deliver energy efficiency measures throughout the scheme and, by providing a very good thermal envelope in combination with the installation of highly efficient heating systems and the added benefit of on-site electricity generation, a 19% improvement will be achieved for the residential units and a 35% improvement for the offices over the energy baseline as per the Merton Core Strategy and the London Plan.

6.0.3 Overall, the residential units will provide a modern, resource efficient, sustainable site, which responds positively to the relevant sustainability planning policies and deliver the following measures:

- A thermally efficient building fabric specification as per Table 8
- Accredited Construction Details for all applicable thermal bridges (and IG Hi-Therm lintels for the dwellings)
- Air-permeability of ~4m^3/hr/m^2
- A communal CHP system with a backup boiler and HIUs to each dwelling
- 6.6 kWp PV Array on the flat roof of the residential block
- AC units to provide comfort cooling
- Efficient lighting design to reduce power consumption
- Efficient water fittings to reduce indoor water demand
- Home Quality Mark ‘level 3’ compliance.

6.0.4 The following measures have also been specified for the commercial block in order to provide an equally modern and sustainable development:

- A thermally efficient building fabric specification as per Table 8
- Accredited Construction Details for all applicable thermal bridges (and IG Hi-Therm lintels for the dwellings)
- Air-permeability of ~5m^3/hr/m^2
- Centralised VRV system to provide heating and cooling for offices
- 10.53kWp PV Array on the flat roof of plant room
- Efficient lighting design as per Figure 10
- Separate metering for all major commercial energy loads, which includes ‘out-of-range’ values (minimum of heating, cooling, lighting and ventilation)
- Efficient water fittings to reduce indoor water demand
- BREEAM 2014 ‘Excellent’ compliance overall.

Unit Type	Commercial (tonnesCO_2/ yr)	% Change	Residential (tonnesCO_2/ yr)	% Change
Energy Baseline	41.05	-	14.20	-
Be Lean	30.67	25.3%	13.99	1.5%
Be Clean	23.47	23.5%	11.14	20.4%
Be Green	19.17	18.3%	9.15	17.9%
Total Cumulative Savings (%)	-	**53.30%**	-	35.56%

Table 17: Proposed Solution Summary

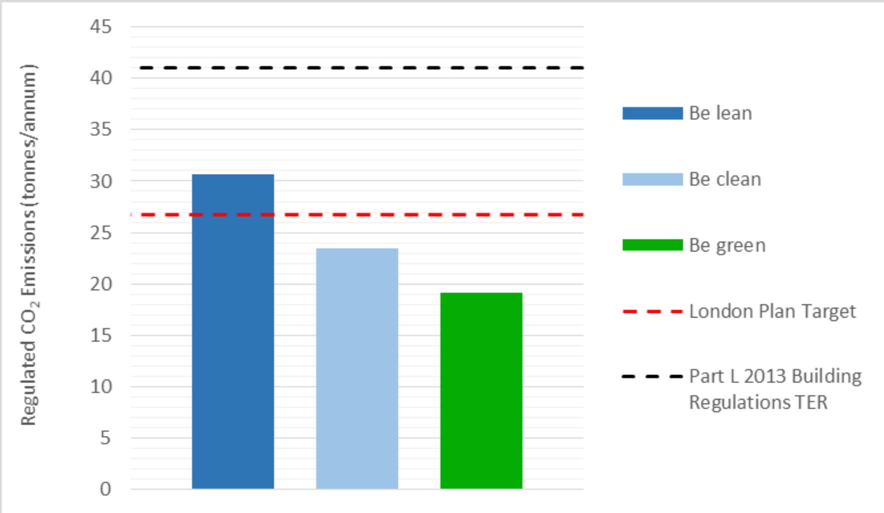


Figure 15: 'Lean, clean and green' Summary New Commercial Areas

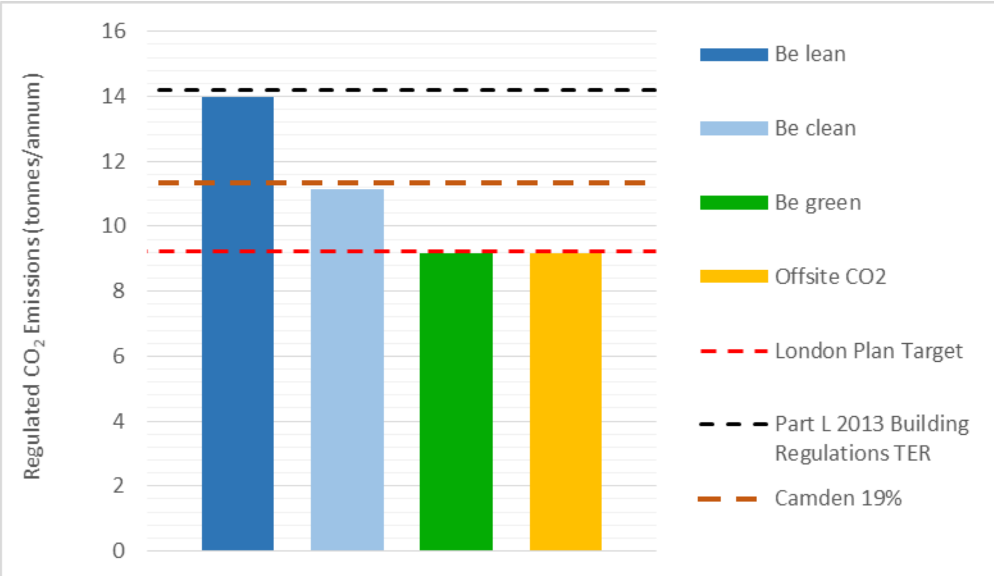


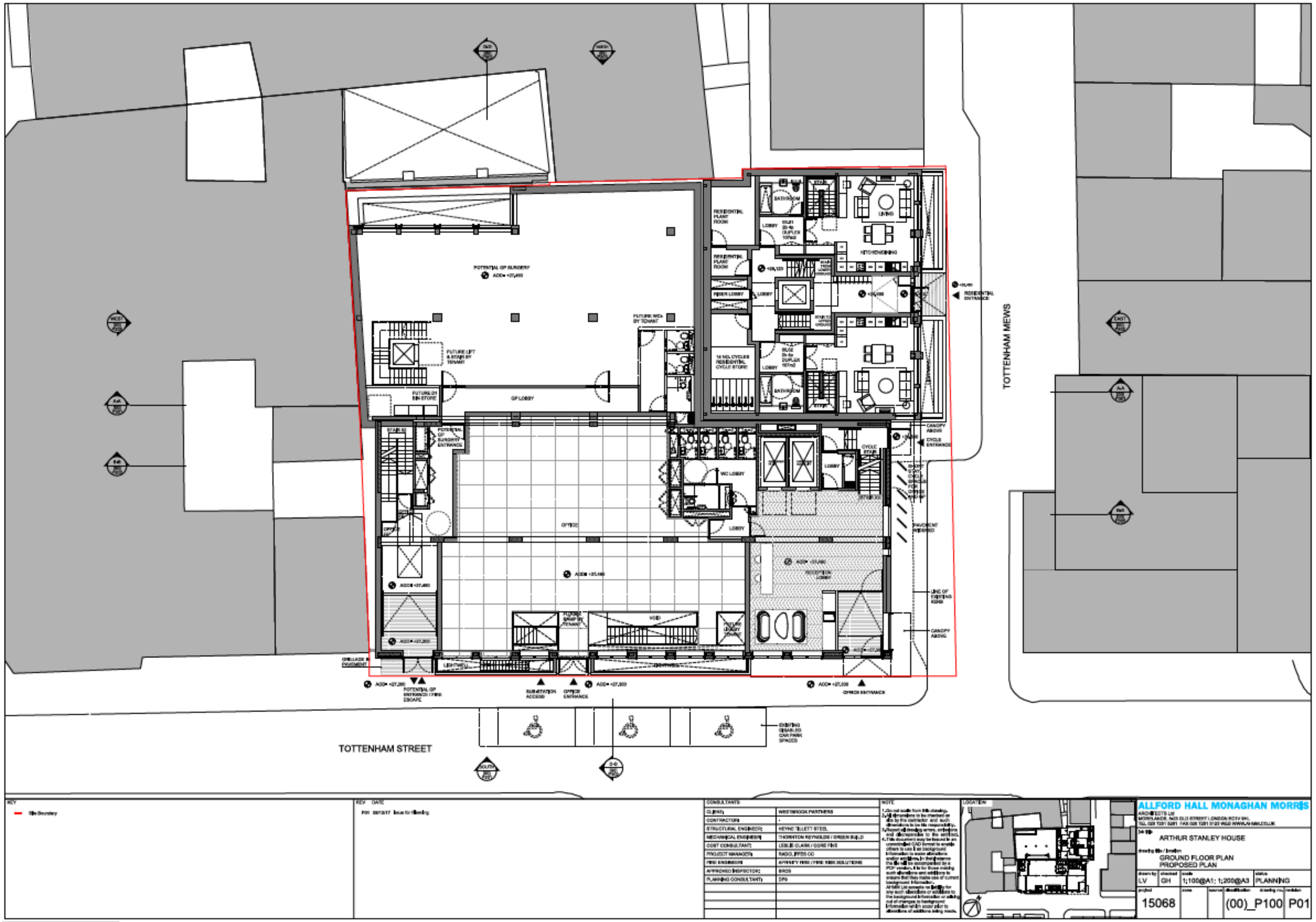
Figure 16: 'Lean, clean and green' Summary Residential Units

6.0.5 Through this approach the Proposed Development has robustly shown compliance with all relevant planning policy:

- Camden Local Plan (2017)

- London Plan (including FALP 2015)

7.0 Appendix A: Proposed Development Upper Floor Plan



8.0 Appendix B: Part G Water Calculator

Building Regulations 2010 Part G	Arthur Stanley, Residential				
		Capacity / flow rate	Use factor	Fixed use (litres/ person/ day)	Litres/ person/ day
WC (single flush)	Flush volume (litres)	0.00	4.42	0.00	0.00
WC (dual flush)	Flush volume (litres)	4.00	1.46	0.00	5.84
	Part flush volume (litres)	2.60	2.96	0.00	7.70
WCs (multiple fittings)	Average flush volume (litres)	0.00	4.42	0.00	0.00
Taps (excluding kitchen / utility)	Flow rate (litres/minute)	4.00	1.58	1.58	7.90
Bath (where shower also present)	Capacity to overflow (litres)	160.00	0.11	0.00	17.60
Shower (where bath also present)	Flow rate (litres/minute)	0.00	4.37	0.00	0.00
Bath only	Capacity to overflow (litres)	0.00	0.50	0.00	0.00
Shower only	Flow rate (litres/minute)	6.00	5.60	0.00	33.60
Kitchen/utility room sink taps	Flow rate (litres/minute)	5.00	0.44	10.36	12.56
Washing machine	Litres/kg dry load	5.50	2.10	0.00	11.55
Dishwasher	Litres/place setting	1.25	3.60	0.00	4.50
Waste disposal unit	Litres/use	0.00	3.08	0.00	0.00
Water softener	Litres/person/day	0.00	1.00	0.00	0.00
				Total calculated use	101.25
				Contribution from greywater (litres/person/day)	0.00
				Contribution from rainwater (litres/person/day)	0.00
				Normalisation factor	0.91
				Total water consumption	92.13
				External water use	5.00
				Total water consumption	97.13

9.0 Appendix C: BRUKL Outputs & SAP Summary Reports

New Commercial BRUKL Document

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Arthur Stanley House Office Compliance   As built

Date: Fri Jun 30 20:04:46 2017

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.7

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.7

BRUKL compliance check version: v5.3.a.0

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	19
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	19
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	8.5
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	0.15	0.15	06000000:Surf[1]
Floor	0.25	0.15	0.15	LB000000:Surf[0]
Roof	0.25	0.15	0.15	06000000:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.13	1.13	0600000C: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/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)] $U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* 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
m³/(h.m²) at 50 Pa	10	5

Existing Commercial BRUKL Document

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Arthur Stanley House Office Compliance As built

Date: Wed Jul 12 15:25:47 2017

Administrative information

Building Details

Address: Address 1, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.7

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.7

BRUKL compliance check version: v5.3.a.0

Owner Details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

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

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	15.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	15.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	9.2
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	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	LB00000F:Surf[2]
Floor	0.25	0.15	0.15	LB000001:Surf[0]
Roof	0.25	0.15	0.15	LB000005:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.13	1.13	0L000001:Surf[1]
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

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* 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
m³/(h.m²) at 50 Pa	10	5

Residential SAP Multiple Compliance Sheet

Buildings Regulations Compliance for Multiple Dwellings

NHER

This report checks compliance against criterion 1 of the Building Regulations where there are multiple dwellings in the same building. Where a building contains more than one dwelling (such as in a terrace of houses or in a block of flats), compliance with the Building Regulations is achieved if:

a) EITHER every individual dwelling has a DER/DFEE that is no greater than its corresponding TER/TFEE

b) OR the average DER/DFEE is no greater than the average TER/TFEE.

The average DER, TER, DFEE and TFEE are all calculated in the same way, using the floor-area-weighted average of all the individual DERs, TERs, DFEEs and TFEEs. Block averaging is permitted only across multiple dwelling in a single building, NOT across multiple buildings on a site.

The formula used is as follows (using the TER as an example):

$\{(TER_1 \times Floor\ area_1) + (TER_2 \times Floor\ area_2) + \ldots + (TER_i \times Floor\ area_i)\} \div \{Floor\ area_1 + Floor\ area_2 + \ldots + Floor\ area_i\}$

Assessor name	Mr Malcolm Maclean	Assessor number	4643
		Created	08/12/2017

Results

URN	Version	Address	Floor Area (m^2)	DER	TER	DFEE	TFEE
GBDC-ARTH-1583-09	6	09 Tottenham Mews	113.00	0.80	23.02	75.4	89.9
GBDC-ARTH-1583-07	6	07 Tottenham Mews	78.81	15.40	19.33	58.7	62.5
GBDC-ARTH-1583-06	6	06 Tottenham Mews	51.14	15.59	21.11	55.2	60.7
GBDC-ARTH-1583-05	6	05 Tottenham Mews	34.77	19.10	24.82	65.2	66.1
GBDC-ARTH-1583-04	6	04 Tottenham Mews	34.02	18.90	24.07	63.7	61.3
GBDC-ARTH-1583-03	6	03 Tottenham Mews	51.14	15.75	21.13	56.0	60.4
GBDC-ARTH-1583-02	6	02 Tottenham Mews	104.80	19.25	22.86	71.1	85.3
GBDC-ARTH-1583-01	6	01 Tottenham Mews	106.00	17.46	22.54	62.1	84.1
GBDC-ARTH-1583-08	6	08 Tottenham Mews	76.19	14.02	19.04	51.4	60.4

Multiple dwelling DER = 14.08

Multiple dwelling TER = 21.85

CO_2 Compliance = PASS

Overall Compliance = PASS

Multiple dwelling DFEE = 63.4

Multiple dwelling TFEE = 74.0

FEE Compliance = PASS