ENERGY & SUSTAINABILITY STATEMENT

307-309 Finchley Road

Produced by XCO2 for Carltone Group

March 2018

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Authorised by	SP	SP				
Date	22/08/2017	28/03/2018				
Project reference	8.996	8.996				

EXECUTIVE SUMMARY

The energy strategy for the development at 307-309 Finchley Road has been developed in line with the energy policies of the London Plan and of Camden's Local Plan. The three-step Energy Hierarchy has been implemented and the estimated regulated CO_2 savings on site are 26.6% for the new build domestic part, 64.7% for the domestic refurbishment, and 67.6% for the non-domestic part of the development, against against an existing building baseline for the refurbishment portion of the scheme, and a Part L 2013 Baseline for new build elements where relevant.

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 307-309 Finchley Road located in the London Borough of Camden.

The proposal comprises the redevelopment of 307-309 Finchley Road and 307 Lithos Road. The scheme will provide additional residential and commercial accommodation through a roof level extension and refurbishment of the Lithos Road frontage of the building.

This document is divided into three parts:

- Planning policies
- Proposed sustainability measures incorporated into the scheme
- Energy Strategy

The Planning Policy section provides an overview of the site and planning policies applicable to this development in accordance with the London Plan and the relevant Camden Council's planning policies.

The second section on proposed sustainability measures outlines the sustainability measures that have been adopted in the team's aim to maximise sustainability within the site and achieve a BREEAM Domestic Refurbishment 'Excellent' rating for the refurbished dwellings. A summary of the pre-assessment credits for the BREEAM assessment are provided at the end of the BREEAM section, demonstrating that the scheme could achieve a score of 73.34%, exceeding the minimum 70% for an 'Excellent' rating.

The third section describes the predicted energy performance and carbon dioxide emissions of the proposed development at 307-309 Finchley Road. For this, the development's extension and new-build part will be compared to a notional building constructed to Part L1A standards, whilst the refurbished parts of the scheme are compared to notional existing baseline building.

Figure 1 summarises the regulated CO_2 savings achieved by the proposed development in comparison to the baseline buildings at each stage of the energy hierarchy. In total, the development is expected to achieve regulated CO_2 savings of 63%. This reduction reflects regulated energy use only, as unregulated energy use (e.g. plug-in appliances) is not taken into account in Part L of the Building Regulations.

The development is expected to achieve regulated CO_2 savings of 63% (44.6% total) across the entire site; 26.6% for the new build domestic part of the development, 64.7% for the domestic refurbishment part of the development, and 67.6% for the commercial refurbishment part of the development.

The regulated CO_2 saving has been achieved by maximising fabric efficiency for both the refurbished and new build aspects. The team aims to improve the building fabric beyond Building Regulations Part L targets through the incorporation of an efficient fabric with low U values, a good air permeability rate and a thermal bridging y-value in line with the Accredited Construction Details for all the new build parts. The design team aims to improve the refurbished elements of the scheme by improving the fabric U values beyond Part L1B and L2B compliance levels and through improving the air tightness of the units as well as upgrading the heating and hot water systems in the scheme.

In summary, the proposed development complies with the London Plan CO_2 savings target of 35% overall. In line with GLA policy, carbon offset payment to zero carbon for the residential elements is not relevant for this scheme.

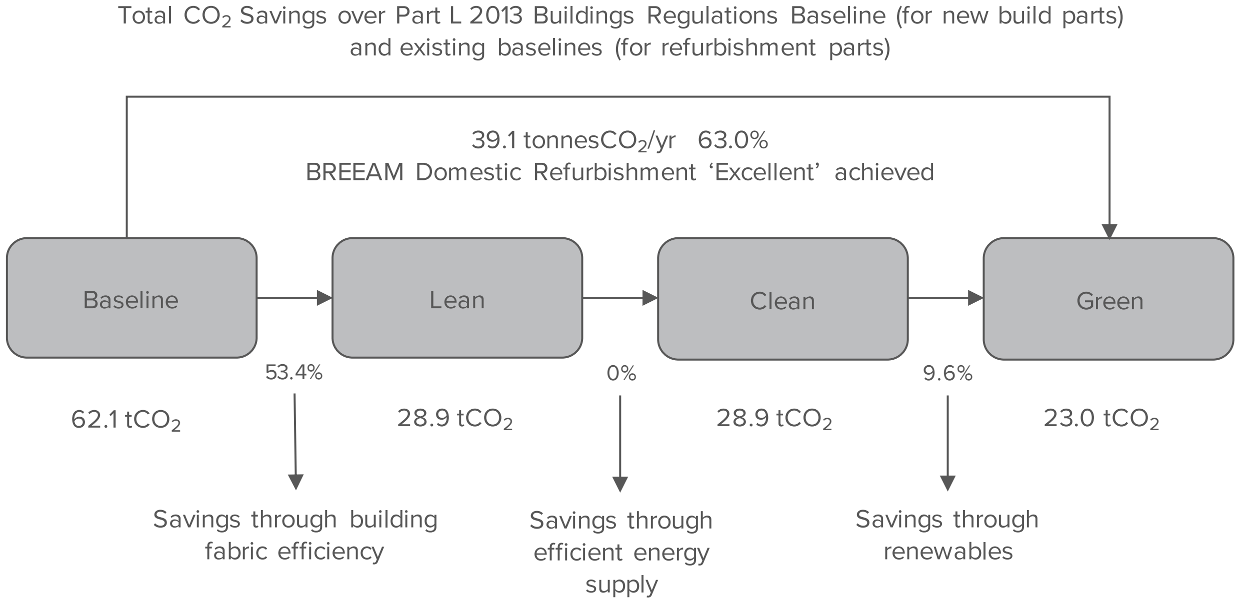


Figure 1: Energy Hierarchy

INTRODUCTION

This Chapter presents the description of the site and of the development proposal, the energy policy framework and the methodology employed for the energy assessment.

SITE & PROPOSAL

The proposal comprises the redevelopment of 307-309 Finchley Road and 307 Lithos Road extension. The proposed scheme will provide additional accommodation, both residential and office use. The proposal also seeks to extend and re-evaluate the late 20th century Lithos Road frontage of the building, in keeping with the wider context of the surrounding site. A new top floor, set back from the main building line is also proposed.

The scheme will generate additional floor space totalling approximately 2,260m^2, whilst current floor space is approximately 1,865m^2. There will be an overall increase in B1 and C3 uses, and retention of A2 use. A number of new residential units is proposed, ranging from studios to 3-bedroom family flats.

Figure 2: Location of the application site.

PLANNING POLICIES

The proposal will seek to respond to the energy and sustainability policies of the London Plan (2016), and of the policies within the London Borough of Camden's Local Plan (2017) and Planning Guidance 3 – Sustainability.

The most relevant applicable energy policies in the context of the proposed development are presented below.

THE LONDON PLAN

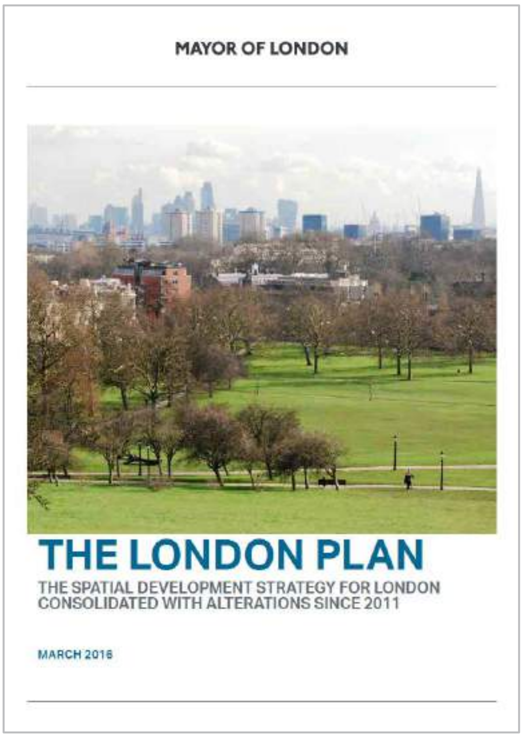
The London Plan (2016) is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years.

The overarching energy policies of the London Plan are included in Chapter Five *London's Response to Climate Change* and include Policies 5.2 to 5.15:

- Policy 5.2: Minimising carbon dioxide emissions;
- Policy 5.3: Sustainable Design and Construction;
- Policy 5.4: Retrofitting;
- Policy 5.7: Renewable energy;
- Policy 5.9: Overheating and cooling; and
- Policy 5.15: Water Use and Supplies.

Extracts of Policies 5.2, 5.6, 5.7 and 5.9 are presented below as these are considered most relevant to the proposed scheme.

The London Plan also consists of a suite of guidance documents, most relevant of which are the Sustainable Design and Construction SPG (April 2014) & Energy Planning – GLA Guidance on preparing energy assessments (March 2016).



POLICY 5.2 MINIMISING CARBON DIOXIDE EMISSIONS

A. Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

Be lean: use less energy
Be clean: supply energy efficiently
Be green: use renewable energy

B. The Mayor will work with boroughs and developers to ensure major developments 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.*

Table 1: CO_2 emissions improvement targets against the current Building Regulations

Residential Buildings	
Year	**Minimum improvement over Building Regulations 2013**
2016 - 2031	Zero Carbon
Non-domestic Buildings	
Year	**Minimum improvement over Building Regulations 2013**
2016 - 2019	35%
2019 - 2031	Zero Carbon

POLICY 5.3 SUSTAINABLE DESIGN AND CONSTRUCTION

"Planning decisions:
B. Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process.
C. Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles:

a. *minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)*
b. *avoiding internal overheating and contributing to the urban heat island effect*
c. *efficient use of natural resources (including water), including making the most of natural systems both within and around buildings*
d. *minimising pollution (including noise, air and urban runoff)*
e. *minimising the generation of waste and maximising reuse or recycling*
f. *avoiding impacts from natural hazards (including flooding)*
g. *ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions*
h. *securing sustainable procurement of materials, using local supplies where feasible, and*
i. *promoting and protecting biodiversity and green infrastructure."*

POLICY 5.4 RETROFITTING

The environmental impact of existing urban areas should be reduced through policies and programmes that bring existing buildings up to the Mayor's standards on sustainable design and construction. In particular, programmes should reduce carbon dioxide emissions, improve the efficiency of resource use (such as water) and minimise the generation of pollution and waste from existing building stock.

POLICY 5.7 RENEWABLE ENERGY

B. Within the framework of the energy hierarchy (see Policy 5.2), major proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.
D. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

POLICY 5.9 OVERHEATING AND COOLING

B. Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

1. *Minimise internal heat generation through energy efficient design*
2. *Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls*
3. *Manage the heat within the building through exposed internal thermal mass and high ceilings*

4. *Passive ventilation*
5. *Mechanical ventilation*
6. *Active cooling systems (ensuring they are the lowest carbon options).*

POLICY 5.15 WATER USE AND SUPPLIES

"...setting an upper limit of daily domestic water consumption to 105 litres/head for residential developments (excluding a maximum allowance of 5 litres/head/day for external water consumption)."

GLA GUIDANCE ON PREPARING ENERGY ASSESSMENTS

This document (last updated in March 2016) provides guidance on preparing energy assessments to accompany strategic planning applications; it contains clarifications on Policy 5.2 carbon reduction targets in the context of zero carbon policy, as well as detailed guidelines on the content of the Energy Assessments undertaken for planning.

The guidance document specifies the emission reduction targets the GLA will apply to applications as follows:

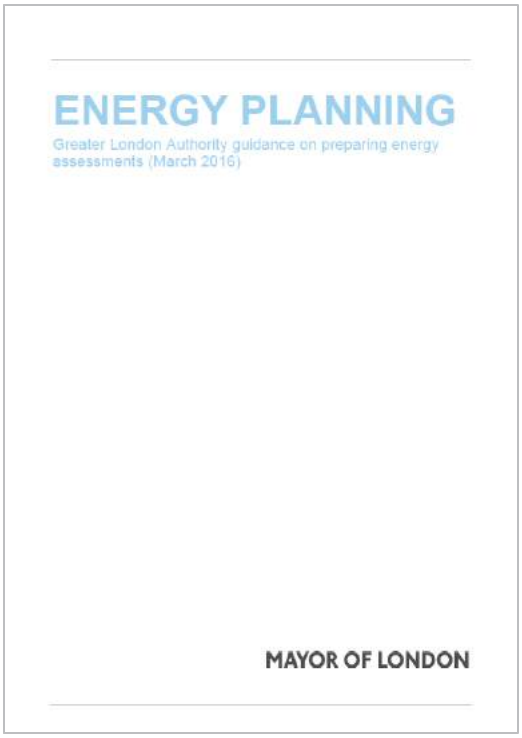
> *Stage 1 schemes received by the Mayor on or after the 1st October 2016: Zero carbon for residential development and 35% below Part L 2013 for commercial development.*

The definition of zero carbon homes is provided in section 5.3 of the guidance:

> *'Zero carbon' homes are homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be offset through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.*

The new guidance also includes changes to technical requirements relating to presenting carbon information separately for domestic and non-domestic elements of developments and the provision for cooling demand data where active cooling is required.

The structure of this report and the presentation of the carbon emission information for the development follows the guidance in this document.


ENERGY PLANNING
Greater London Authority guidance on preparing energy assessments (March 2016)
MAYOR OF LONDON

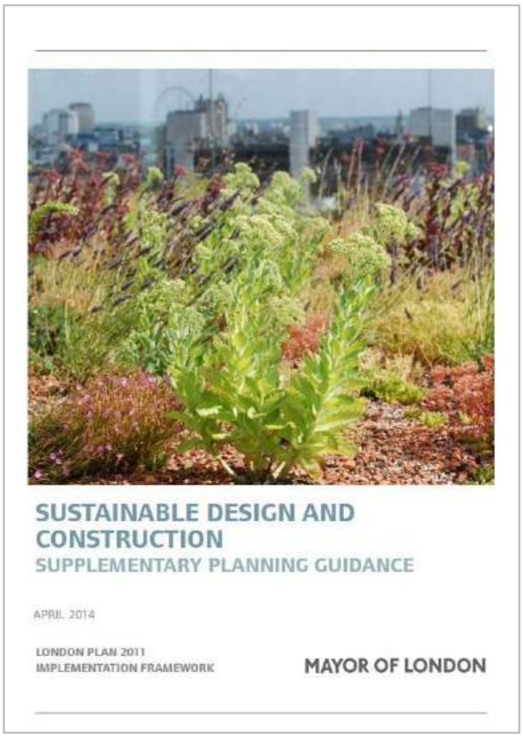
SUSTAINABLE DESIGN AND CONSTRUCTION SPG

The Sustainable Design and Construction SPG, adopted in April 2014, provides additional information and guidance to support the implementation of the Mayor's London Plan. The SPG does not set new policy, but explains how policies in the London Plan should be carried through into action.

It is applicable to all major developments and building uses so it is not technically applicable to this development, however in line with the developer's intention to implement the requirements of the London Plan it has been used to guide the design. It covers the following areas:

- Resource Management
- Adapting to Climate Change and Greening the City
- Pollution Management

This SPG provides a basis for sustainable design in London and is used as the overarching structure of this report. Where additional local policies are addressed by these areas this has also been indicated.

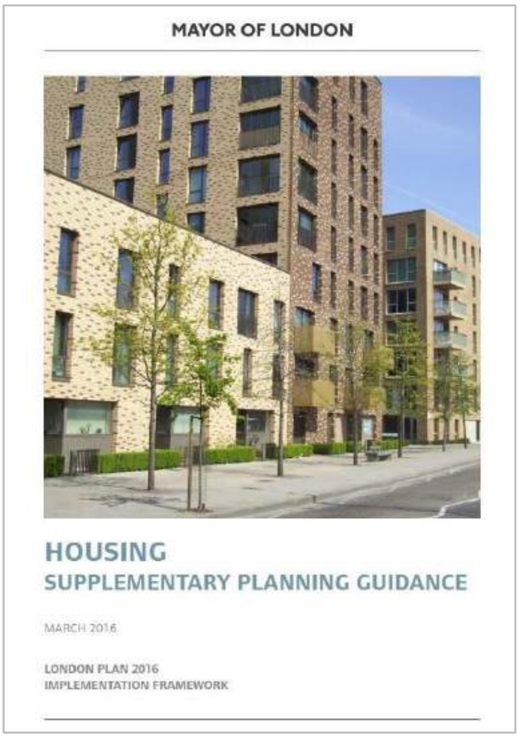


HOUSING SPG

This document provides guidance on the implementation of housing policies in the London Plan and it replaces the 2012 Housing SPG.

Part 2 covers housing quality and updates London housing standards to reflect the implementation of the government's new national technical standards through the Minor Alterations to the London Plan (2015-2016).

As design affects the quality of life, health & wellbeing, safety and security of users and neighbours, this guidance is integral to sustainable development and will be cross-referenced as relevant in the subsequent sections.



CAMDEN LOCAL PLAN -2017

The Camden Local Plan sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning documents (adopted in 2010). The Local Plan in particular will help deliver the objectives of creating the conditions for harnessing the benefits of economic growth, reducing inequality and securing sustainable neighbourhoods.

The policies relevant to energy and sustainability are outline below:

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:

- a. *promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;*
- b. *require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;*
- c. *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;*
- d. *support and encourage sensitive energy efficiency improvements to existing buildings;*
- e. *require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and*
- f. *expect all developments to optimise resource efficiency.*

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

- g. *working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;*
- h. *protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and*
- i. *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. To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.*


Camden Local Plan
Adoption version
June 2017

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

- a. *the protection of existing green spaces and promoting new appropriate green infrastructure;*
- b. *not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;*
- c. *incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and*

d. *measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.*

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. *ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;*
f. *encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;*
g. *encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and*
h. *expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.*

Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a. *incorporate water efficiency measures;*
b. *avoid harm to the water environment and improve water quality;*
c. *consider the impact of development in areas at risk of flooding (including drainage);*
d. *incorporate flood resilient measures in areas prone to flooding;*
e. *utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and*
f. *not locate vulnerable development in flood-prone areas.*

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

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:

a. *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;*

b. *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;*

c. *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*

d. *make sure that developments include facilities for the storage and collection of waste and recycling.*

CAMDEN PLANNING GUIDANCE - SUSTAINABILITY CPG3 - 2013

It is expected that this Guidance would be updated since the new Local Plan has been adopted in June 2017.

The Camden Planning Guidance support the policies set out in the Local Development Framework (LDF). While the Camden LDF contains policies relating to sustainability in their Core Strategy and Development Policies documents, the Council also has a separate planning guidance specific to sustainability. The sections that will be covered by the following sections of this Sustainability Statement are listed below:

The energy hierarchy
All new developments are to be designed to minimise carbon dioxide emissions by being as energy efficient as is feasible and viable.

Energy efficiency: new buildings
All new developments are to be designed to minimise carbon dioxide emissions by being as energy efficient as is feasible and viable.

Decentralised energy networks and combined heat and power
Development should follow the Energy Hierarchy

1. use less energy
2. supply energy efficiently
3. use renewable energy

Renewable Energy
All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

Water Efficiency
The Council expect all development to be designed to be water efficient by minimising water use and maximising the re-use of water. This includes new and existing buildings.

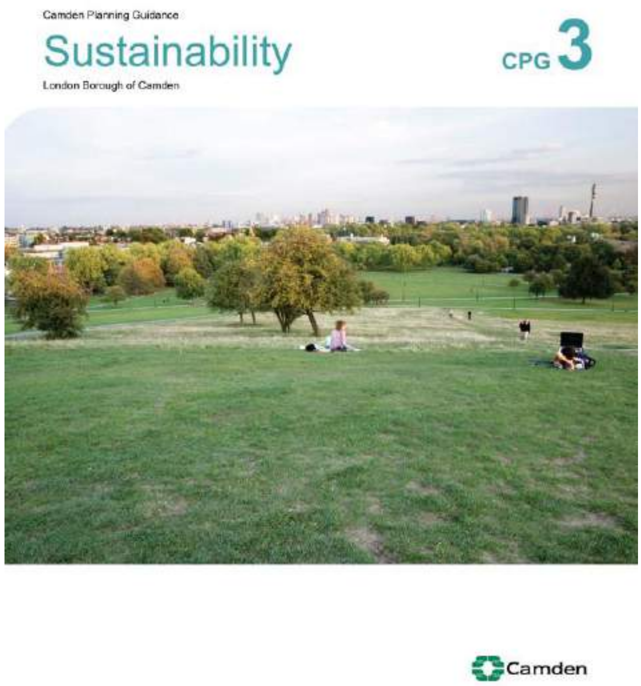
Sustainable use of materials
Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.

Sustainability assessment tools
Developments are anticipated to be able to achieve BREEAM 'Excellent' from 2013 onwards and at least 60% of Energy and Water credits and 40% of Materials credits.

Brown roofs, green roofs and green walls
The Council will expect all developments to incorporate brown roofs, green roofs and green walls unless it is demonstrated this is not possible or appropriate. This includes new and existing buildings. Special consideration will be given to historic buildings to ensure historic and architectural feature are preserved.

Flooding
Developments must not increase the risk of flooding, and are required to put in place mitigation measures where there is known to be a risk of flooding.

Adapting to climate change
All development is expected to consider the impact of climate change and be designed to cope with the anticipated conditions



PROPOSED SUSTAINABILITY MEASURES

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Sustainability measures will also include outline key sustainability items.

Due to the area of the non-domestic portion of the development being less than 500m^2, a BREEAM assessment is not required for this part of the development. The proposed sustainability measures for the non-domestic and new build portions of the scheme will be in line with Local Plan Policies CC1 to CC5, and the recommendations presented in Camden's Planning Guidance Part 3 on Sustainability. The domestic refurbishment portion of the development will be assessed under BREEAM Domestic Refurbishment, and a pre-assessment is presented later in the report.

The following subsections detail the sustainability measures that will be incorporated into the design of the development as a whole. The proceeding section furthers this, describing the specific measures required for the refurbished domestic portion of the development.

ENERGY

DWELLING AND BUILDING EMISSION RATE AND FABRIC ENERGY EFFICIENCY

The methodology set out by the Department of Energy and Climate Change (DECC) for assessing the energy use of dwellings is the Standard Assessment Procedure (SAP). The current version is SAP 2012. For non-domestic buildings, SBEM has been used.

Preliminary SAP and SBEM calculations were carried out to assess the potential CO_2 savings achieved through

- Energy efficiency measures
- The efficient supply of energy and
- Renewable systems

The preliminary calculations showed an improvement over baseline buildings and Part L Building Regulations 2013 where relevant, amounting to a 63% reduction in regulated CO_2 emissions for the scheme.

The energy demand of the development will be reduced by maximising fabric efficiency for both refurbished and new build portions of the development. This will be done by improving the building fabric beyond Building Regulations Part L through incorporation of high levels of insulation, accredited thermal bridging details and good levels of air tightness to improve the building's fabric efficiency. SAP and SBEM calculations were based on a building fabric with low U-values and an air permeability rate of 5m^3/m^2.h at 50 Pa for new build and 10m^3/m^2.h at 50 Pa for refurbished spaces.

DRYING SPACE

The proposed dwellings will include provisions for internal or external clothes drying where appropriate, thereby reducing the amount of electricity consumed through the use of tumble dryers.

ENERGY LABELLED WHITE GOODS

The dwellings will be supplied with an EU Energy Efficiency Labelling Scheme Leaflet to help the tenants choose energy efficient white goods or energy efficient white goods where the dwellings have been fitted out.

EXTERNAL LIGHTING

Energy efficient light fittings will be installed throughout the development where appropriate. In addition, external lights will be fitted with controls to reduce the energy consumption of the building during periods of infrequent use:

- External space lighting will include energy efficient fittings
- Security lighting will include daylight cut-off devices, with a maximum wattage of 150W and PIR.

LOW OR ZERO CARBON TECHNOLOGIES

A feasibility study was carried out to determine the energy strategy for the proposed development. The proposed strategy has surpassed Part L Building Regulations due to the reduction in the demand by a highly efficient shell. Photovoltaics have been proposed for the residential portion of the development, whilst air source heat pumps (ASHPs) are proposed for the commercial, achieving 9.6% reduction in CO_2 emissions compared to the Baseline stage, and 20.6% compared to the Be Lean stage, which meets Camden's Local Plan Policy CC1.

CYCLE STORAGE

Communal cycle storage spaces will be provided for use by the residents to reduce the frequency of short car journeys. The cycle storage will be adequately sized and secured.

WATER

INDOOR WATER USE

The development at 307-309 Finchley Road aims to reduce water consumption in the dwellings to less than 96 litres per person per day, lower than the new target set out within the London Plan (Minor Alterations to the London Plan 2016), through the use of water efficient fittings, and these are listed below.

Fitting	Consumption per use
WC (full flush)	4 litres per flush
WC (half flush)	2.6 litres per flush
Kitchen sink tap	6 litres per min
Wash basin tap	5 litres per min
Bath	150 litres to overflow
Shower	7 litres per min
Washing machine	8.17 litres per kilogram
Dishwasher	1.25 litres per place setting

MATERIALS

Embodied energy is the energy that is used in the manufacture, processing and the transportation of the materials to site.

The construction build-ups for each of the main building elements are rated from A+ to E. Each element to be used in the building has been rated according to the BRE Green Guide to Specification whereby:

- A+ rated elements are least likely to affect the environment
- E rated elements are most likely to affect the environment

It is assumed that most of the main building elements within this development will achieve between an A+ to C rating where possible.

All timber used during site preparation and construction to be FSC certified, and all non-timber materials to be certified with Environmental Management Systems (ISO 14001 OR BES 6001) where possible.

WASTE

HOUSEHOLD WASTE

Dedicated external waste storage for the dwellings will be provided to meet the Local Authority requirements.

Adequate internal storage for recyclable waste will be provided to all dwellings in a dedicated position. The Local Authority provides recyclable household waste collection and sorting. Communal waste storage space will be provided for both commercial and residential parts of the development.

CONSTRUCTION SITE WASTE MANAGEMENT

The development will minimise the impact of construction waste on the environment through a Resource Management Plan or Strategy. This plan will include information such as:

- Benchmarks for resource efficiency
- Procedures and commitments to reduce hazardous and non-hazardous waste
- Monitoring hazardous and non-hazardous waste

POLLUTION

GLOBAL WARMING POTENTIAL (GWP) OF INSULANTS

Global warming potential (GWP) is a measure of how effective a gas is at preventing the passage of infrared radiation. Blowing agents, used in the production of insulation, are a common source of gases with high GWPs.

The development will aim to specify insulation materials that have a low Global Warming Potential (GWP).

NO_X EMISSIONS

Space heating and hot water requirements are to be met through high efficiency gas boilers with inherently low NOx emissions.

HEALTH AND WELLBEING

DAYLIGHTING

The dwellings have been designed with daylight in mind and measures have been taken to maximise daylight where possible.

SOUND INSULATION

The development proposes that airborne sound insulation will comply with current Building Regulations Part E standards.

LIFETIME HOMES

All dwellings will aim to be designed in line with Lifetime Homes principles where possible, ensuring that they are easily adaptable for future use.

MANAGEMENT

CONSTRUCTION SITE IMPACTS

To minimise the construction impacts of the site, the contractor will strive to monitor, report and set targets for:

- The production of CO_2 arising from site activities
- Water consumption from site activities

In addition, contractors will strive to adopt best practice policies for air (dust) and water (ground and surface) pollution occurring on site. All timber will be sourced following the Government's Timber Procurement Policy.

ECOLOGY

ECOLOGICAL VALUE OF SITE & PROTECTION OF ECOLOGICAL FEATURES

Due to its urban location and absence of ecological features on the existing site, the site is considered to be of low ecological value.

BUILDING FOOTPRINT

The proposed development will increase the density of the site. This will ensure that the land is used efficiently whilst maximising the building area.

SURFACE WATER RUN-OFF

There will be no increase in the man-made impermeable area draining to the watercourse, therefore there will be no increase in peak rate of run-off over the development lifetime.

The Environment Agency flood map shows the proposed development to be located within an area at low risk of flooding. A detailed Sustainable Urban Drainage Systems Strategy for the proposed development can be found in the following section.

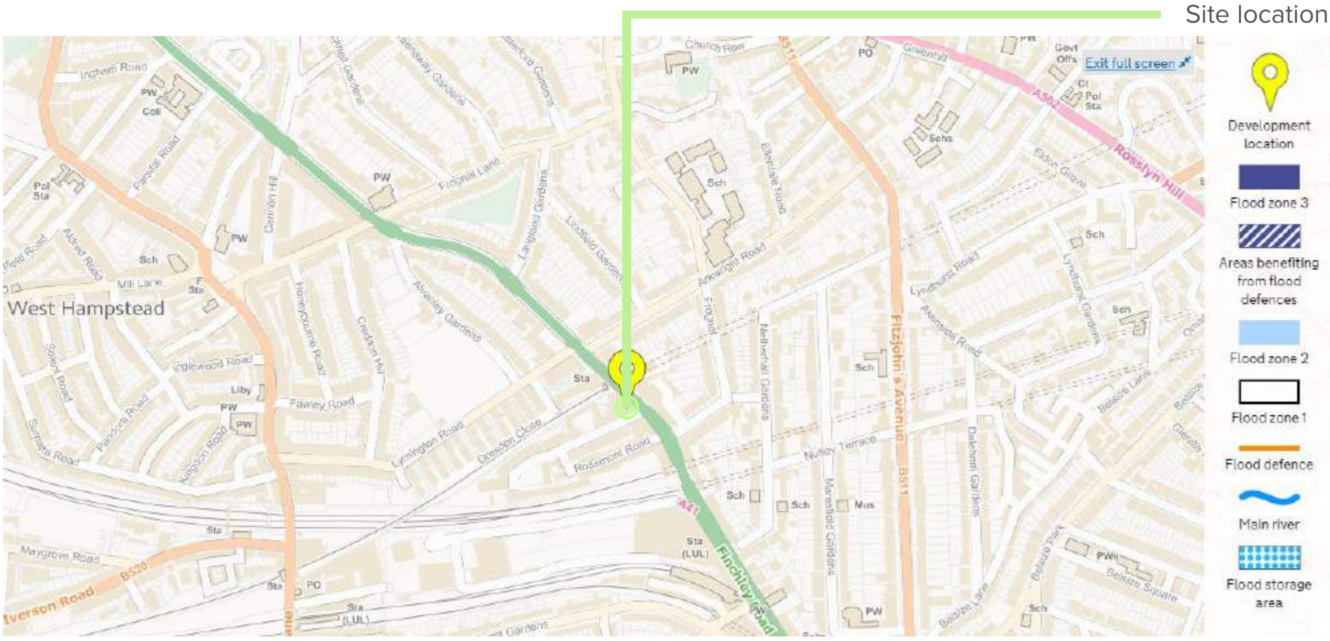


Figure 3: Flood map for local area

SUSTAINABLE URBAN DRAINAGE SYSTEMS

The total site area is approximately 528m^2 and is considered to be impermeable in its entirety. This impermeable area consists of both existing and proposed roof space. Pre and post development surface water runoff calculations showing the peak flow rate leaving the site can be found in Appendix D.

The onsite surface water would be managed in a sustainable manner to mimic the surface water flow arising from the site prior to the proposed development. This management strategy should aim to reduce flood risk to the site itself as well as elsewhere in the catchment while taking the influence of climate change into account.

The most effective way of managing flood risk at urban sites is through reducing the rate of surface water discharge. Historically, traditional piped systems transport surface water through our developments as quickly as possible, however this has proven to cause a number of additional adverse impacts including downstream flooding, reduced ground water levels, dry water flow and surface water contamination through run-off contamination.

EXISTING DRAINAGE NETWORKS

The Thames Water asset plan in Appendix E shows that there is a combined sewer running along both Lithos Road and Finchley Road. The closest manhole to the development site is located immediately north east of the site. The elevation of this manhole is shown to be 59.4m AOD with an invert level of 54.85m AOD on the asset plan

PROPOSED SUDS SOLUTION

The suggested SUDS solution aims to treat rainwater at source as far as possible, reducing the burden on existing Thames Water infrastructure. As the development involves the refurbishment and extension of an existing developed site located within a dense urban environment it is not considered possible to increase the area of permeable space. For this reason it is deemed most appropriate to integrate onsite storage and attenuation in order to reduce runoff as far as feasibly possible.

Policy 5.13 (Sustainable Drainage) of the London Plan states that developments should aim to achieve greenfield runoff rates and ensure that surface water run-off is managed as close to its source as possible. In the case of the proposed development site, greenfield runoff rate was calculated at 0.08 l/s.

Due to the urban nature, density of the site the application of natural infiltration SUDS techniques was considered unrealistic. For this reason the scheme will utilise onsite rainwater attenuation. As a result of the proposed attenuation, runoff is determined by the nature of the flow control device (Hydro-brake or similar approved) that restricts outflow to the local sewer system to 5l/s.

For the proposed 307-309 Finchley Road development it has been decided that the most appropriate SUDS strategy would be the integration of 4.2m^3 of storage in the form of a rainwater attenuation tank. It was decided that the most appropriate location for this tank would be at basement level, allowing all site runoff to naturally drain to the lowest point of the site. This system would provide the total storage requirement to cope with the runoff rate following a 1 in 100 year, 6 hour storm event. This stored water will be channelled to the closest manhole located to the north east of the development site. As the proposed attenuation tank will be located at below ground level it will be necessary for the installation of a water pump to assist the flow of water from the site to the local combined sewer system.

This analysis has fully considered the Sustainable Urban Drainage hierarchy. With the information provided it has been proven that with the addition of a basement level attenuation tank the outflow will be reduced to 5l/s and thus reduce the flood risk and burden on existing Thames Water Infrastructure currently associated with the development site

SUSTAINABILITY STANDARDS

Within the Draft Core Strategy (2016), the BREEAM standard of 'Excellent' is required for all residential refurbishments with 5 or more dwellings. The following Pre-Assessment demonstrates compliance with the Local Authority's policies in relation to BREEAM assessments.

BREEAM DOMESTIC REFURBISHMENT 2014

BREEAM Domestic Refurbishment is a performance based assessment method and certification scheme for domestic buildings undergoing refurbishment. The primary aim of BREEAM Domestic Refurbishment is to improve the environmental performance of existing dwellings in a robust and cost effective manner. This is achieved through integration and use of the scheme by clients and their project teams at key stages in the refurbishment process.

A BREEAM Domestic Refurbishment Pre-Assessment was carried out for the residential refurbishment element of the development.

The pre-assessment tool uses established benchmarks to evaluate a building's specification, design, construction and operation, over a broad range of categories and criteria:

- Management processes
- Health and wellbeing
- Energy use
- Transport
- Water use
- Materials
- Waste
- Land use and ecology
- Pollution
- Innovation

The outcome of the pre-assessment is expressed as a single certified BREEAM rating, ranging from Pass (30%) to Outstanding (85%).

Table 2: BREEAM Certification Thresholds

BREEAM 2014 Rating	Percentage of Credits Required
Outstanding	85%
Excellent	70%
Very Good	55%
Good	45%
Pass	30%

The following section discusses how the development addresses the BREEAM sustainability criteria required to meet BREEAM 'Excellent'.

Each of the sustainability categories as set out in BREEAM are addressed; each sub-section highlights the sustainability measures that have been adopted to meet BREEAM 'Excellent'.

MANAGEMENT

MAN01 Home User Guide

A 'Home User Guide' will be made available to the main dwellings providing occupants with an understanding of the energy associated with the operation of their home. This non-technical guide will include operational instructions, recommendations on improving energy use and information on the surrounding area (local amenities) to obtain full credits in this section.

MAN02 Responsible Construction Practices

The tender specification will require contractors to be compliant with the Considerate Constructors Scheme (CCS). Additional credits have been awarded as it is expected that formal certification will be achieved and that contractors will operate beyond best practice with a score of 35-39 with a score of at least 7 in each section.

MAN03 Construction Site Impacts

To minimise the construction impacts of the site, contractors will be required to monitor, report and set targets for the reduction of CO_2 arising from site activities in respect to energy and CO_2 emissions, and water consumption.

MAN04 Security

All external doors and windows will meet minimum security standards and be appropriately certified. A suitably qualified security consultant will be consulted at the design stage, with their recommendations incorporated into the refurbishment specification.

MAN06 Project Management

All of the project team has been involved in the project decision-making and individual and shared roles and responsibilities have been assigned by the project manager across the following key design and refurbishment stages:

- Planning and Building control notification
- Design
- Refurbishment
- Commissioning and handover
- Occupation

Key design team meetings will be held to define and make key decisions that influence or affect the dwelling's proposed designs, and their refurbishment in accordance with the design (and therefore the dwelling's sustainability impacts and BREEAM performance).

As part of the handover and aftercare strategy a handover meeting will be arranged and two or more of the following items will be committed to:

- A site inspection within 3 months of occupation.
- Conduct post occupancy interviews with building occupants or a survey via phone or posted information within 3 months of occupation.
- Longer term after care e.g. a helpline, nominated individual or other appropriate system to support building users for at least the first 12 months of occupation.

HEALTH AND WELLBEING

HEA01 Daylighting

The refurbishment will be designed to result in a neutral impact on the dwellings daylighting levels in the kitchen, living room, dining room and study.

HEA02 Sound Insulation

Existing separating walls and floors will be designed to achieve airborne sound insulation levels 3dB higher than Part E and impact sound levels 3dB lower than Part E. This will be confirmed through sound testing post-completion.

HEA05 Ventilation

The minimum ventilation levels set out in Sections 5 and 7 of Building Regulations Approved Document Part F will be provided for all habitable rooms, kitchens, utility rooms and bathrooms.

HEA06 Safety

Fire and carbon monoxide detection systems will be installed as part of the refurbishment and extension. A compliant fire detection and alarm system will also be provided.

ENERGY

ENE01 Improvement in Energy Efficiency Rating (EER)

The Energy Efficiency Rating (EER) is a measure of the overall efficiency of a dwelling. It accounts for regulated energy use in terms of heating, hot water, equipment, lighting and auxiliary energy use.

The methodology set out by the Department of Energy and Climate Change (DECC) for assessing the energy use of dwellings is the Standard Assessment Procedure (SAP). The current version of software is FSAP 2012.

Preliminary SAP calculations were carried out to assess the potential CO_2 savings achieved through energy efficiency measures.

The preliminary SAP calculation for the proposed development at 307-309 Finchley Road showed considerable reductions in energy demand in comparison to the existing building. The SAP calculation results indicate that the EER will increase by an average of 19 for the refurbished dwellings.

ENE02 Energy Efficiency Rating (EER) Post Refurbishment

Reduction in energy demand of the proposed dwellings will be achieved through the use of well insulated external building elements, high performance glazing, use of efficient lighting throughout the dwellings, and the installation of energy efficient space heating and hot water systems.

SAP calculations show that an average EER of 80 will be achieved. This exceeds the EER of 70 required to meet BREEAM Domestic Refurbishment 'Excellent'.

ENE03 Primary Energy Demand

An average primary energy demand of less than 120 kWh/m^2/year will be achieved after refurbishment works are carried out for the development at 307-309 Finchley Road.

ENE05 Energy Labelled White Goods

The dwellings will be supplied with energy efficient appliances that are recognised as having the following ratings in the EU Energy Efficiency Labelling Scheme.

- Fridges, freezers & fridge-freezers: A+
- Washing machines: A++
- Dishwashers: A+
- Washer dryers & tumble dryers A>

ENE06 Drying Space

The proposed refurbishment will include provisions for clothes drying, thereby reducing the amount of electricity consumed through the use of tumble dryers. The development will include at least 4m of retractable drying lines in 1-2 bedroom dwellings and at least 6m of retractable drying line in 3+ bedroom dwellings.

ENE07 Lighting

External - Energy efficient light fittings will be installed in the external spaces. Existing external lighting will also meet the compliance requirements.

In addition, external lights will be fitted with controls to reduce the energy consumption of the building during periods of infrequent use:

- external space lighting will include energy
- efficient fittings
- security lighting will include daylight cut-off devices, with a maximum wattage of 150W and
- PIR

Internal lighting will have a maximum average wattage across the total floor area of 9 watts/m^2.

ENE08 Energy Display Devices

Energy display devices will be installed in all dwellings to enable the occupants to gain an understanding of their energy consumption and to enable them to reduce their energy use in the future.

The display device will provide information on current electricity and primary heating consumption data and will be capable of recording consumption data.

ENE09 Cycle Storage

At least 20 cycle storage spaces will be provided for the site. This is to reduce the frequency of short car journeys. The cycle storage space will be adequately sized, secure, covered and accessible to all residents.

ENE10 Home Office

Each proposed dwelling will allow for a home office space in an appropriate room comprising:

- sufficient space for a chair, desk and bookshelf
- adequate ventilation
- 2 No. double power sockets and
- 2 No. telephone sockets (or one telephone
- socket where broadband is provided)

WATER

WAT01 Internal Water Use

The water category aims to reduce the consumption of potable water in the home from all sources. These are mandatory credits within BREEAM Domestic Refurbishment, with BREEAM 'Excellent' setting an upper limit of 107 litres per person per day.

The proposed development aims to reduce water consumption through the use of water efficient fittings, including dual flush toilet, water efficient shower heads and taps.

It is estimated that the proposed refurbishment and extension will achieve a water consumption rate of less than 96 litres/person/day, exceeding the minimum requirement for BREEAM Domestic Refurbishment 'Excellent'.

WAT02 External Water Use

As the development have no individual or communal garden space, this credit has been awarded by default.

MATERIALS

MAT01 Environmental Impact of Materials

Embodied energy is the energy that is used in the manufacture, processing and the transportation of the materials to site.

The construction build-ups for each of the main building elements are rated from A+ to E. Each element to be used in the building has been rated according to the BRE Green Guide to Specification whereby:

- A+ rated elements are least likely to affect the environment
- E rated elements are most likely to affect the environment

It is assumed that most of the main building elements within this development will achieve between an A+ to C rating.

MAT02 & MAT03 Responsible Sourcing of Materials and Insulation

The principal contractor will source materials in accordance with a documented sustainable procurement plan and at least 80% of the materials specified will be obtained from responsible sources.

This includes all basic building elements, comprising the building frame, floors, roof, external walls, foundations and internal walls and all finishing elements.

In addition, 100% of all timber used on site will be legally sourced, thereby satisfying the mandatory requirements set out in this category. Any timber used in the structural and finishing elements will be specified from certified sustainable sources such as FSC or PEFC.

Where possible, on-site materials will be reused and recycled to lower transport CO_2 emissions associated with off-site recycling. Where practicable, materials with a high recycled or waste content will be specified.

The insulation index for all new insulation used in external walls, floors, roof and building services will be more than 2 when calculated using the BREEAM Mat03 Insulation Calculator.

WASTE

WAS01 Household Waste

A Local Authority Collection Scheme will be in operation for the collection of mixed recyclable household waste, at least 30 litres of storage space for recycling will be provided internally at a dedicated position in the kitchen.

WAS02 Construction Site Waste Management

The development will minimise the impact of construction waste on the environment through a Level 2 Site Waste Management Plan (SWMP). This plan will include:

- benchmarks for resource efficiency
- procedures and commitments to reduce
- hazardous and non-hazardous waste
- monitoring hazardous and non-hazardous
- waste

The amount of waste generated will be recorded in the SWMP, and the volume of non-hazardous construction waste generated from the development will meet or exceed the target resource efficiency benchmark. If demolition is included as part of the refurbishment programme, then the audit should also cover demolition materials. In addition, pre-refurbishment audit of the existing building will be completed prior to works commencing on site.

POLLUTION

POL01 NOx Emissions

This section aims to reduce the release of nitrogen oxide (NOx) into the atmosphere. Space heating and hot water requirements of the dwellings will be met by high efficiency gas boiler with low inherent NOx emissions. Gas boilers with NOx emissions of less than 40 mg/kWh will be specified.

POL02 Surface Water Runoff

The building footprint will remain the same after the refurbishment, therefore there will be a neutral impact on surface water.

POL03 Flooding

The Environment Agency flood map shows the site to be at low risk of flooding. Please refer to image 3 in Page 21.

BREEAM PRE-ASSESSMENT RESULTS

A BREEAM pre-assessment has been undertaken at pre-application stage which has shown that a score of 73.34 is feasible. This includes the minimum requirements from Camden Council for Energy and Water (at least 60% of available credits) and Materials (at least 40% of available credits).

The results for the pre-assessment are summarised in the table below, and include a breakdown of the currently targeted score for each issue and category.

Table 3: BREEAM Pre-Assessment Breakdown

BREEAM Category	Total Credits Available	Score Assessment		
		Sub-total	Weighting	Score (%)
Management	11	11	12%	12.0%
Health & Wellbeing	12	8	17%	11.3%
Energy	29	10	43%	30.4%
Water	5	4	11%	8.80%
Materials	48	22	8%	3.6%
Waste	5	4	3%	2.4%
Pollution	8	5	6%	3.75%
Innovation	10	1	-	1.0%
BREEAM 'Excellent'		**Total Points Scored: 73.34%**		

ENERGY STRATEGY SUMMARY

This section describes the predicted energy performance and carbon dioxide emissions of the proposed 307-309 Finchley Road development based on the information provided by the design team.

METHODOLOGY - BE LEAN, BE CLEAN, BE GREEN

The methodology used to determine CO_2 emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2A) outlined below. The development will be compared to existing baseline buildings and Building Regulations Part L 2013 baseline.

The reductions made through each step have been outlined here:

BE LEAN - USE LESS ENERGY

The first step addresses reduction in energy demand, through the adoption of passive and active design measures.

The proposed energy efficiency measures include levels of insulation beyond Building Regulation requirements, low air tightness levels, efficient lighting as well as energy saving controls for space conditioning and lighting.

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by:

- 0.3% (0.01 tonnes per annum) for the new build domestic part of the development;
- 56.5% (25.5 tonnes per annum) for the refurbishment domestic part of the development;
- 57.3% (7.7 tonnes per annum) for the non-domestic part of the development; and
- 53.4% (33.2 tonnes per annum) across the whole site.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The application site is located in an area where district heating is not expected to be implemented in the future.

A site heat network has not been found to be feasible or viable for a development of this scale; individual high efficiency gas boilers are instead proposed to provide heat to the dwellings. There will be no additional savings at this step.

BE GREEN - USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified photovoltaics and air source heat pumps as suitable technologies for the development.

The incorporation of renewable technologies will further reduce CO_2 emissions *on site* by a further:

- 26.3% (1.0 tonnes per annum) for the new build domestic part of the development;
- 8.2% (3.7 tonnes per annum) for the refurbished domestic part of the development;
- 10.3% (1.4 tonnes per annum) for the non-domestic part of the development; and
- 9.6% (5.9 tonnes per annum) across the site as a whole.

The scheme will also achieve a 20.6% reduction in regulated CO2 emission with LZC technologies when compared to the Be Lean Stage, which meets the 20% target set out in Camden's Local Plan Policy CC1.

CUMULATIVE ON SITE SAVINGS

The overall regulated CO_2 savings *on site* against existing buildings baseline and Part L 2013 compliant scheme are therefore:

- 26.6% (1.0 tonnes per annum) for the new build domestic part of the development;
- 64.7% (29.1 tonnes per annum) for the refurbishment domestic part of the development; and
- 67.6% (9.1 tonnes per annum) for the non-domestic part of the development.

The total regulated CO_2 savings for the site are 39.1 tonnes, equivalent to 63% of the baseline emissions, and exceeding the 35% reduction target set out in the London Plan for major developments.

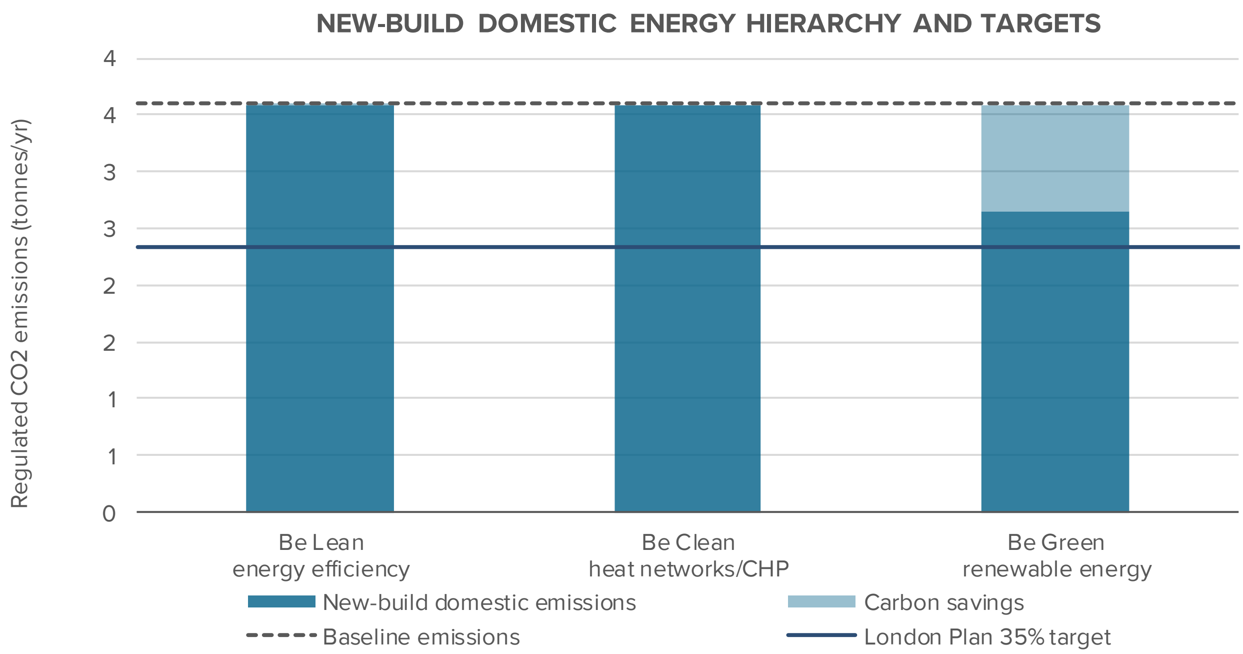


Figure 4: The New Build Domestic Energy Hierarchy

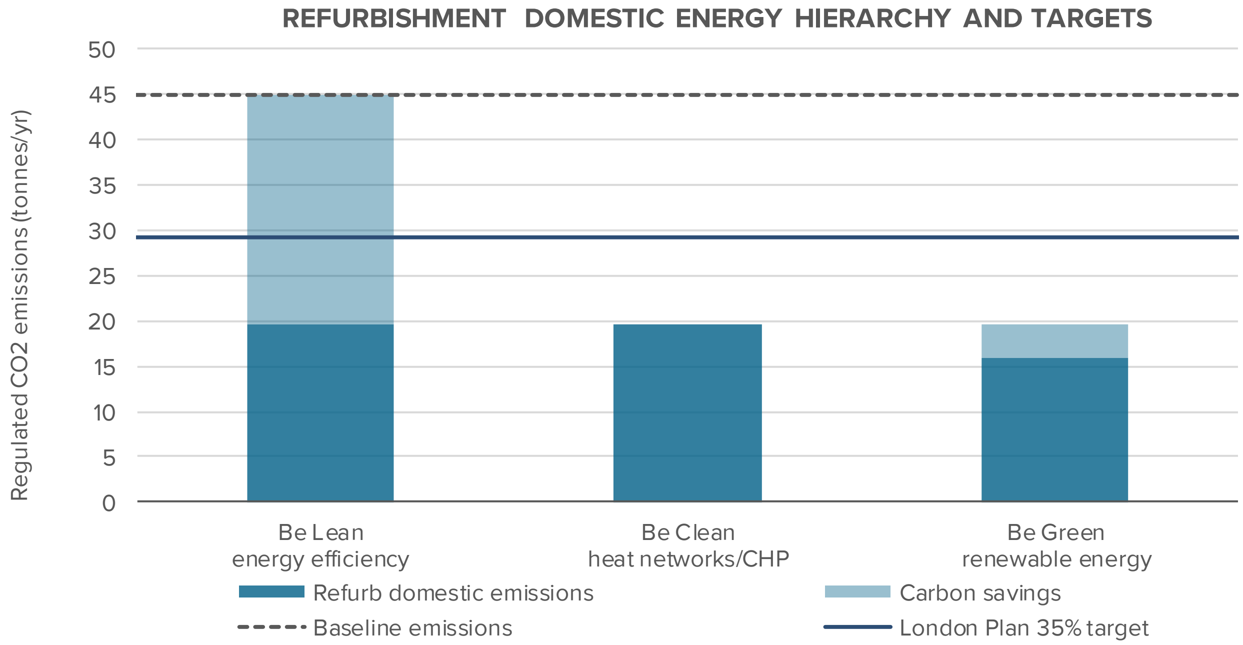


Figure 5: The Refurbishment Domestic Energy Hierarchy

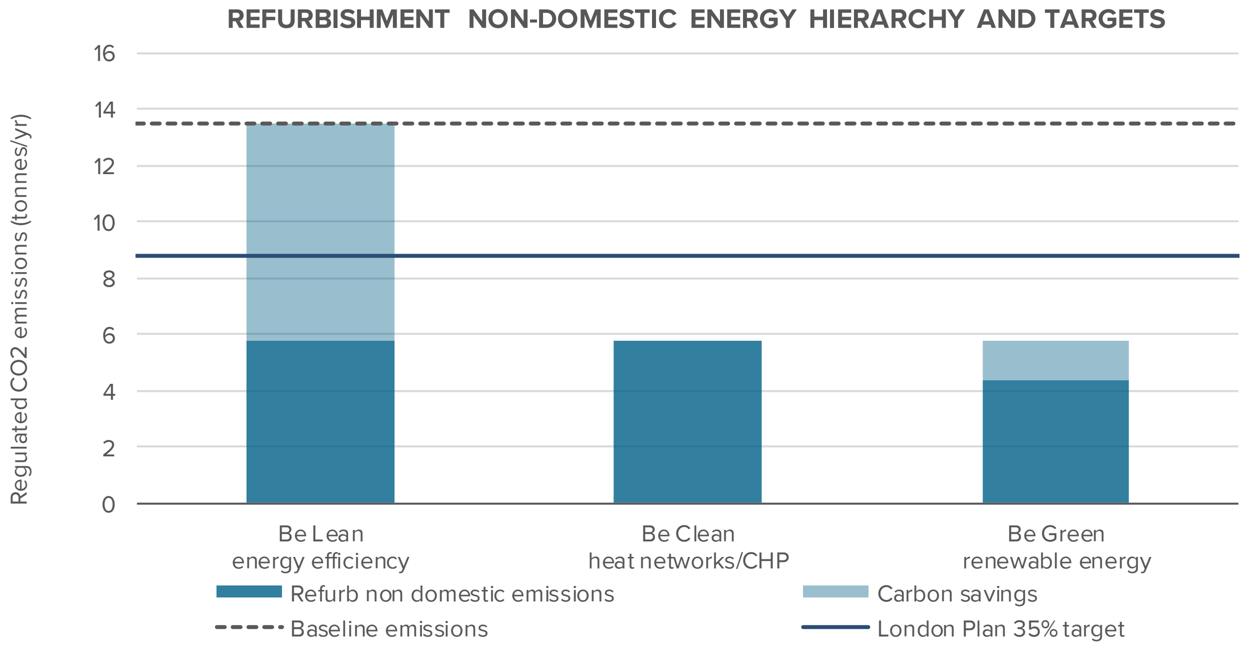


Figure 6: The Non-Domestic Energy Hierarchy

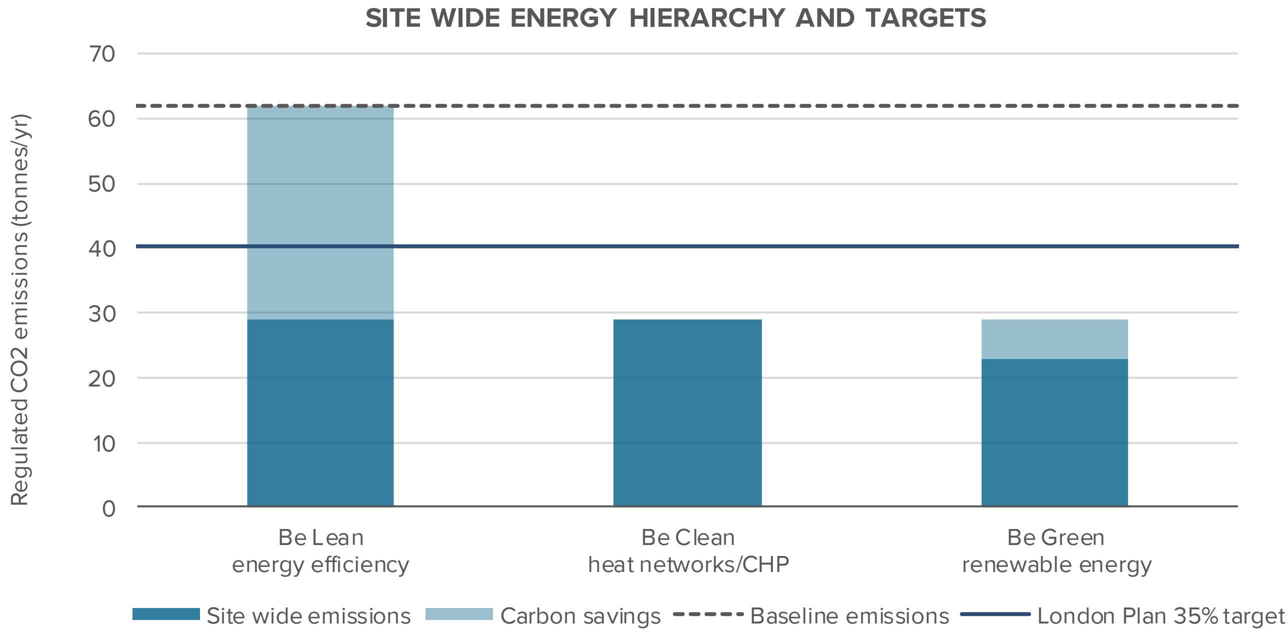


Figure 7: The Site Wide Energy Hierarchy

BE LEAN – USE LESS ENERGY

The proposal incorporates a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water and lighting. Measures will also be put in place to reduce the risk of overheating. The regulated carbon saving achieved in this step of the Energy Hierarchy is 53.4% over the site wide baseline level.

PASSIVE DESIGN MEASURES

ENHANCED U-VALUES

The heat loss of different building fabric elements is dependent upon their U-value. A building with low U-values provides better levels of insulation and reduced heating demand during the cooler months.

The proposed development will incorporate high levels of insulation and high-performance glazing beyond notional building specifications, in order to reduce the demand for space conditioning (heating and/or cooling).

The tables to the right demonstrate the improved performance of the proposed building fabric for both new build and refurbishment domestic and non-domestic uses.

Table 4: Thermal Envelope U-values

New Build Domestic (U-values in W/m².K)			
Element	**Building Regulations**	**Proposed**	**Improvement**
Walls	0.30	0.15	50%
Roof	0.20	0.10	50%
Windows	2.00	1.40	30%
Refurbishment (U-values in W/m².K)			
Element	**Existing**	**Proposed**	**Improvement**
Walls	1.70	0.30	82%
Floor	0.53	0.25	55%
Roof	1.50	0.18	88%
Windows	4.80	1.60	67%

AIR TIGHTNESS IMPROVEMENT

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration.

The proposed development will aim to improve upon the Part L 2013 minimum standards for air tightness by targeting air permeability rates of $5m^3/m^2$ at 50Pa for all new build units and $10m^3/m^2$ at 50Pa for refurbished areas.

REDUCING THE NEED FOR ARTIFICIAL LIGHTING

The development has been designed to maximise daylight in all habitable spaces.

All of the habitable areas will benefit from generous glazing area to increase the amount of daylight within the internal spaces where possible. This is expected to reduce the need for artificial lighting whilst delivering pleasant, healthy spaces for occupants.

ACTIVE DESIGN MEASURES

HIGH EFFICACY LIGHTING

The development intends to incorporate low energy lighting fittings throughout the residential and non-residential spaces. All light fittings will be specified as low energy lighting, and will accommodate LED, compact fluorescent (CFLs) or fluorescent luminaries only.

HEAT RECOVERY VENTILATION

Mechanical ventilation heat recovery (MVHR) is proposed for the commercial units. The mechanical ventilation system will include heat recovery in order to achieve ventilation in the most energy-efficient way. Natural ventilation is proposed for the dwellings.

COMFORT COOLING

Air source heat pumps with high energy efficiency ratios may be used for both heating and cooling in the commercial units, therefore the impact of active cooling in terms of energy use and carbon emissions will be minimised.

CONTROLS

Advanced lighting controls will be incorporated, specifically for areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate for the commercial parts of the development.

MONITORING

Apart from the above design measures, the development will incorporate monitoring equipment and systems to enable occupiers to monitor and reduce their energy use.

Smart meters will be installed to monitor the heat and electricity consumption of each dwelling; the display board will demonstrate real-time and historical energy use data and will be installed at an accessible location within the dwellings.

ENERGY USE

The table below shows a breakdown of carbon dioxide emissions associated with the proposed development's fossil fuel and electricity consumption for the different uses. The site-wide data are presented, i.e. the sum of the demand for both the domestic and non-domestic parts of the development. The figures provide a comparison between the baseline condition and the proposed development once energy efficiency measures (Lean) have been applied.

This table demonstrates the energy savings achieved through energy efficiency measures (Lean stage of the Energy Hierarchy)

Table 5: Breakdown of energy consumption and CO_2 emissions for the baseline and the proposed schemes after 'Lean' measures are implemented

	Baseline			Lean		
	Energy (kWh/yr.)	$kgCO_2$ /yr.	$kgCO_2/m^2$	Energy (kWh/yr.)	$kgCO_2$ /yr.	$kgCO_2/m^2$
Hot Water	58,670	12,800	11.1	34,590	7,550	6.5
Space Heating	157,620	37,800	32.8	62,590	14,070	12.2
Cooling	6,480	3,280	2.8	3,420	1,730	1.5
Auxiliary	3,100	1,590	1.4	1,370	700	0.6
Lighting	12,810	6,570	5.7	9,470	4,850	4.2
Equipment	43,880	22,770	19.7	46,320	24,040	20.8
Total Part L	238,670	62,050	53.8	111,440	28,900	25.0
Total (incl. equipment)	282,560	84,830	73.5	157,760	52,940	45.9

BE LEAN CO_2 EMISSIONS & SAVINGS

By means of energy efficiency measures alone, regulated CO_2 emissions are shown to reduce by:

- 0.3% (0.01 tonnes per annum) for the new build domestic part of the development;
- 56.5% (25.5 tonnes per annum) for the domestic refurbishment part of the development;
- 57.3% (7.7 tonnes per annum) for the non-domestic part of the development; and
- 53.4% (33.2 tonnes per annum) across the whole site.

BE CLEAN – SUPPLY ENERGY EFFICIENTLY

The development site does not lie in the vicinity of an existing or proposed district energy network, and a communal CHP network would not be viable for this scale of development. Communal heating has also been disregarded given the associated design, cost and maintenance implications of incorporating and operating a communal plantroom and the lesser efficiency of such a system compared to an individualised solution. The proposed system for space heating and hot water is therefore individual high efficiency gas boilers.

ENERGY SYSTEM HIERARCHY

The energy system for the development has been selected in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy 5.6 states that energy systems should consider:

1. Connection to existing heating and cooling networks;
2. Site wide CHP network; and,
3. Communal heating and cooling.

Local heat and power sources minimise distribution losses and achieve greater efficiencies when compared to separate energy systems, thus reducing CO_2 emissions.

In a communal energy system, energy in the form of heat, cooling, and/or electricity is generated from a central source and distributed via a network of insulated pipes to surrounding residences.

CONNECTION TO AN EXISTING NETWORK

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map can be seen on the following page which shows the energy demand for different areas. Darker shades of red signify areas where energy demand is high. The map also highlights any existing and proposed district heating networks within the vicinity of the development.

SITE WIDE CHP NETWORK

The small scale of the development would not render the option of a site wide CHP network a feasible or viable option.

COMMUNAL HEATING

A centralised system is not suitable to a development of this size, due to the relatively large space required for the plant room, the small number of households to cover the capital costs and the small overall demand for heating rendering the centralised system inefficient.

INDIVIDUAL HEATING

Space heating and hot water for the development will therefore be provided by individual high efficiency gas boilers. Compared to a communal boiler heating system, individual boilers will be more efficient to run and maintain, therefore delivering higher carbon savings.

Given that it has not been found feasible or viable for the proposed development to incorporate the supply of low carbon heating, no carbon savings are achieved for this step of the Energy Hierarchy.

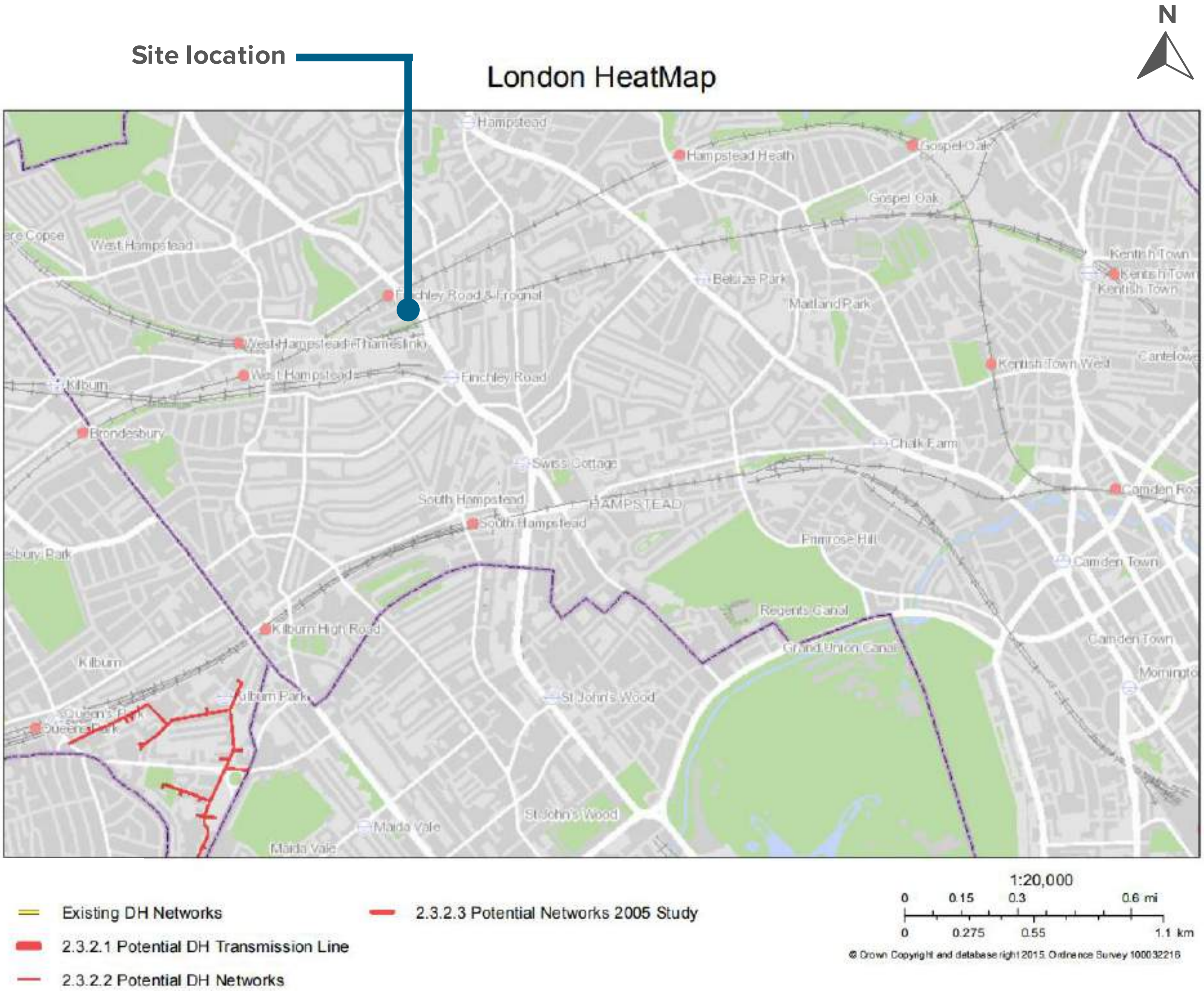


Figure 8: Excerpt from the London Heat Map

BE GREEN – USE RENEWABLE ENERGY

The renewable technologies feasibility study carried out for the development identified photovoltaics for the domestic part of the development and air source heat pumps for the commercial part of the development as suitable technologies. The regulated carbon saving achieved in this step of the Energy Hierarchy is 9.6% over the site wide baseline level.

RENEWABLE TECHNOLOGIES FEASIBILITY STUDY

Methods of generating on-site renewable energy (Green) were assessed, once Lean and Clean measures were taken into account.

The development of 307-309 Finchley Road will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance. A range of renewable technologies were subsequently considered including:

- Biomass;
- Ground/water source heat pumps;
- Air source heat pump;
- Wind energy;
- Photovoltaic panels, and,
- Solar thermal panels.

In determining the appropriate renewable technology for the site, the following factors were considered:

- CO_2 savings achieved;
- Site constraints; and
- Any potential visual impacts.

RENEWABLE ENERGY APPRAISAL SUMMARY

The table below summarises the factors taken into account in determining the appropriate renewable technologies for this project. This includes estimated capital cost, lifetime, level of maintenance and level of impact on external appearance. The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being infeasible). It is important to note that the information provided is indicative and based upon early project stage estimates.

The feasibility study demonstrates that photovoltaics and ASHP would be the most feasible renewable technologies for the proposed 307-309 Finchley Road development. Detailed assessments for the proposed technologies can be found in the following sections.

Table 6: Summary of renewable technologies feasibility study

		Comments	Lifetime	Maintenance	Impact on external appearance	Site feasibility
Biomass		Not adopted -burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location.	20 yrs.	High	High	2
PV		Adopted	25 yrs.	Low	Med	9
Solar thermal		Not adopted - PV is deemend to be the most effective roof mouted renewable solution	25 yrs.	Low	Med	3
GSHP		Not adopted -the installation of ground boreholes requires significant space, additional time at the beginning of the construction process and very high capital costs.	20 yrs.	Med	Low	0
ASHP		Adopted	20 yrs.	Med	Med	8
Wind		Not adopted - Wind turbines located at the site will have a significant visual impact on the existing locally listed building.	25 yrs.	Med	High	2

DETAILED ASSESSMENT OF PHOTOVOLTAIC PANELS

Four types of solar cells are available on the market at present and these are mono-crystalline, poly-crystalline, thin film and hybrid panels. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Photovoltaics are considered a suitable technology for this development for the following reasons:

- The development provides an extent of roof space for the installation of PV panels;
- PV arrays are relatively easy to install when compared to other renewable systems; and
- PV panels provide a significant amount of CO_2 savings.

The PV shall comprise 11.6kWp (72.2m^2) of horizontal roof mounted arrays. The PV array will be connected to the domestic part of the development (landlord areas).

The table to the right summarises the technical data for the proposed PV array and estimated CO_2 savings from the application of this technology. In total, the PV installation would produce regulated CO_2 savings of 7.3% for the development.

An indicative area for the installation of the PV panels on the roof can be found in the following page.

Table 7: Summary of technical/operational data and estimated CO_2 savings for PVs

Photovoltaics		
Module efficiency	16	%
Tilt	Horizontal	
Predicted site solar energy	950.6	kWh/m^2.yr
System losses	20	%
System peak power	11.55	kWp
Array area	72.16	m^2
Primary energy offset by PV	8,780	kWh/yr.
Total CO_2 savings	4.6	t/yr.
Regulated baseline CO_2 emissions	62.1	t/yr.
Total baseline CO_2 emissions	84.8	t/yr.
% Regulated CO_2 reduction*	9.6	%
% Total CO_2 reduction*	7.0	%

* % reduction from site baseline

Figure 9: Monocrystalline PV arrays

Space available for PV

N

Figure 10. Proposed PV layout for 307-309 Finchley Road

DETAILED ASSESSMENT OF AIR SOURCE HEAT PUMPS

Air source heat pumps (ASHPs) employ the same technology as ground source heat pump (GSHPs). However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

The efficiency of heat pumps is very much dependent on the temperature difference between the heat source and the space required to be heated. As a result, ASHPs tend to have a lower COP than GSHPs. This is due to the varying levels of air temperature throughout the year when compared to the relatively stable ground temperature. The lower the difference between internal and external air temperature, the more efficient the system.

ASHP is considered a suitable technology for the commercial part of the development for the following reasons:

- It is a high efficiency system that can cater for the space heating and cooling of the non-domestic areas of the proposed development;
- Requires less capital cost than GSHP and other renewable technologies; and
- It can be integrated with the proposed ventilation strategy.

This technology may be employed to provide the space heating and cooling for future fit-out of the non-domestic parts of the development.

The table below summarises the technical data for the proposed ASHP and estimated CO_2 savings from the application of this technology. In total, the ASHP technology would produce regulated CO_2 savings of 2.2% for the development.

Table 8: Summary of technical/operational data and estimated CO_2 savings for ASHP

ASHP for non-domestic spaces		
COP heating	4.0	
COP cooling	6.0	
Carbon intensity of electricity	0.519	kgCO2/kWh
Proportion of non-domestic space heating and hot water met by ASHP	0	%
Proportion of non-domestic space cooling met by ASHP	100	%
Energy met by ASHP	10,590	kWh/yr.
Energy used by ASHP	2,620	kWh/yr.
Total CO_2 savings	1.4	t/yr.
Regulated baseline CO_2 emissions	62.1	t/yr.
Total baseline CO_2 emissions	84.8	t/yr.
% Regulated CO_2 reduction*	2.2	%
% Total CO_2 reduction*	1.6	%

* % reduction from site baseline

Figure 11: Outdoor unit of an ASHP

BE GREEN CO_2 EMISSIONS & SAVINGS

The incorporation of renewable technologies will further reduce CO_2 emissions by a further:

- 26.3% (1.0 tonnes per annum) for the new build domestic part of the development;
- 8.2% (3.7 tonnes per annum) for the domestic refurbishment part of the development;
- 10.3% (1.4 tonnes per annum) for the non-domestic part of the development; and
- 9.6% (5.9 tonnes per annum) across the whole site.

CONCLUSIONS

Following the implementation of the three-step Energy Hierarchy, the cumulative CO_2 savings on site are estimated at 26.6% for the new build domestic and 64.7% for the domestic refurbishment parts, and 67.6% for the non-domestic part of the development, against an existing buildings baseline and Part L 2013 compliant scheme. The regulated CO_2 savings for the site as a whole are 63%.

ON SITE CO_2 SAVINGS

By implementing the three step Energy Hierarchy as detailed in the previous sections, the Regulated CO_2 emissions for the development have been reduced against a Part L 2013 compliant scheme through on site measures alone by:

- 26.6% (2.6 tonnes per annum) for the new build domestic part of the development;
- 64.7% (29.1 tonnes per annum) for the domestic refurbishment part of the development;
- 10.3% (9.1 tonnes per annum) for the non-domestic part of the development; and
- 63% (39.1 tonnes per annum) across the whole site.

The proposed development complies with the London Plan CO_2 savings target of 35% overall. The target 20% reduction in regulated CO_2 emissions from LZC technologies (when compared to the Be Lean Stage) set out in the Camden Local Plan is also achieved through the installation of photovoltaics and air source heat pumps.

The tables on the following pages summarise the implementation of the Energy Hierarchy for the proposed scheme and detail the CO_2 emissions and savings against the baseline scheme for each step of the hierarchy.

Separate tables are presented for the new build domestic, domestic refurbishment and non-domestic refurbishment parts of the development; as well as for the site as a whole.

Overall, the proposed development has been designed to meet energy policies set out by the GLA and the London Borough of Camden, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

In line with GLA policy, carbon offset payment to zero carbon for the residential elements is not relevant for this scheme.

SUSTAINABILITY

In summary, the proposed 307-309 Finchley Road development will meet the targets set out by Camden Council and the Greater London Authority (GLA). The scheme achieves a BREEAM score of 73.34%, exceeding the BREEAM 'Excellent' target of 70%.

The credits obtained in the BREEAM pre-assessment and the site-wide sustainability measures incorporated reflect the client and design team's aspirations in integrating sustainability measures and demonstrates that the project is designed to exceed the planning policy sustainability requirements.

DOMESTIC CUMULATIVE SAVINGS

Table 9: CO_2 emissions after each step of the Energy Hierarchy for the new build domestic part of the development

	Carbon dioxide emissions for new build domestic part (tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline	3.6	3.6
After energy demand reduction	3.6	3.6
After heat network/CHP	3.6	3.6
After renewable energy	2.64	3.6

Table 10: Regulated CO_2 savings from each stage of the Energy Hierarchy for the new build domestic part of the development

	Regulated new build domestic part carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Savings from energy demand reduction	0.01	0.3%
Savings from heat network/CHP	0.0	0.0%
Savings from renewable energy	0.95	26.3%
Cumulative on site savings	0.96	26.6%

Table 11: CO_2 emissions after each step of the Energy Hierarchy for the domestic refurbishment part of the development

	Carbon dioxide emissions for domestic refurbishment part (tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline	45.0	15.6
After energy demand reduction	19.5	15.6
After heat network/CHP	19.5	15.6
After renewable energy	15.86	15.6

Table 12: Regulated CO_2 savings from each stage of the Energy Hierarchy for the domestic refurbishment part of the development

	Regulated domestic refurbishment part carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Savings from energy demand reduction	25.4	56.5
Savings from heat network/CHP	0.0	0.0
Savings from renewable energy	3.7	8.2
Cumulative on site savings	29.1	64.7

NON-DOMESTIC CUMULATIVE SAVINGS

Table 13: CO_2 emissions after each step of the Energy Hierarchy for the non-domestic refurbishment part of the development

	Carbon dioxide emissions for non-domestic refurbishment part (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline	13.5	3.5
After energy demand reduction	5.8	3.5
After heat network/CHP	5.8	3.5
After renewable energy	4.4	3.5

Table 14: Regulated CO_2 savings from each stage of the Energy Hierarchy for the non-domestic refurbishment part of the development

	Regulated non-domestic refurbishment part carbon dioxide savings	
	Tonnes CO_2 per annum	% over baseline
Savings from energy demand reduction	7.7	57.3
Savings from heat network/CHP	0.0	0.0
Savings from renewable energy	1.4	10.3
Cumulative on site savings	9.1	67.6

SITE-WIDE CUMULATIVE SAVINGS

Table 15: Site wide regulated CO_2 emissions and savings

	Total regulated emissions (tonnes CO_2/year)	Regulated CO_2 savings (tonnes CO_2/year)	Percentage saving (%)
Baseline	62.1		
Be Lean	28.9	33.2	53.4%
Be Clean	28.9	0.0	0.0%
Be Green	23.0	5.9	9.6%
Total	62.1	39.1	63.0%

APPENDIX A – OVERHEATING RISK ASSESSMENT

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 22 August 2017

Property Details: Flat 2

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	2
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	8 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	339.23	**(P1)**
Transmission heat loss coefficient:	42.1	
Summer heat loss coefficient:	381.32	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
North West (NW)	0	1
South East (SE)	0	1
North West (NW Basement)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
North West (NW)	1	0.9	1	0.9	**(P8)**
South East (SE)	1	0.9	1	0.9	**(P8)**
North West (NW Basement)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
North West (NW)	0.9 x	2.4	98.85	0.7	0.8	0.9	107.61	
South East (SE)	0.9 x	6	119.92	0.7	0.8	0.9	326.38	
North West (NW Basement)	0.9 x	3.8	98.85	0.7	0.8	0.9	170.38	
						Total	604.36	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	286.45	275.06	281.33	
Total summer gains	929.17	879.42	813.23	**(P5)**
Summer gain/loss ratio	2.44	2.31	2.13	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	18.69	20.46	20.18	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 22 August 2017

Property Details: Plot 4

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	No
Number of storeys:	2
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	5 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	186.72	**(P1)**
Transmission heat loss coefficient:	56.6	
Summer heat loss coefficient:	243.37	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South East (SE)	0	1
North East (NE)	0	1
North East (NE Basement)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South East (SE)	1	0.9	1	0.9	**(P8)**
North East (NE)	1	0.9	1	0.9	**(P8)**
North East (NE Basement)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South East (SE)	0.9 x	4.6	119.92	0.7	0.8	0.9	250.23	
North East (NE)	0.9 x	3.1	98.85	0.7	0.8	0.9	138.99	
North East (NE Basement)	0.9 x	2.3	98.85	0.7	0.8	0.9	103.12	
						Total	492.34	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	265.18	254.69	260.62	
Total summer gains	789.23	747.03	692.13	**(P5)**
Summer gain/loss ratio	3.24	3.07	2.84	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.49	21.22	20.89	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

Assessment of likelihood of high internal temperature: Slight

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 22 August 2017

Property Details: Plot 6

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	487.84	**(P1)**
Transmission heat loss coefficient:	63.4	
Summer heat loss coefficient:	551.2	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
North East (NE)	0	1
South West (SW)	0	1
South East (SE)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
North East (NE)	1	0.9	1	0.9	**(P8)**
South West (SW)	1	0.9	1	0.9	**(P8)**
South East (SE)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
North East (NE)	0.9 x	5.4	98.85	0.7	0.8	0.9	242.12	
South West (SW)	0.9 x	3.2	119.92	0.7	0.8	0.9	174.07	
South East (SE)	0.9 x	1.5	119.92	0.7	0.8	0.9	81.6	
						Total	497.78	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	405.07	388.74	397.15	
Total summer gains	934.83	886.52	833.73	**(P5)**
Summer gain/loss ratio	1.7	1.61	1.51	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	17.95	19.76	19.56	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 22 August 2017

Property Details: Plot 8

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	386.51	**(P1)**
Transmission heat loss coefficient:	50.5	
Summer heat loss coefficient:	436.96	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South East (SE)	0	1
South West (SW)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South East (SE)	1	0.9	1	0.9	**(P8)**
South West (SW)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South East (SE)	0.9 x	3.6	119.92	0.7	0.8	0.9	195.83	
South West (SW)	0.9 x	1.4	119.92	0.7	0.8	0.9	76.16	
						Total	271.98	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	343.98	330.4	338.2	
Total summer gains	629.5	602.38	591.93	**(P5)**
Summer gain/loss ratio	1.44	1.38	1.35	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	17.69	19.53	19.4	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Not significant**	**Not significant**	

Assessment of likelihood of high internal temperature: Not significant

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 22 August 2017

Property Details: Plot 10

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	No
Number of storeys:	1
Front of dwelling faces:	Unspecified
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Medium
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	4 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	114.39	**(P1)**
Transmission heat loss coefficient:	17.7	
Summer heat loss coefficient:	132.12	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
North East (NE)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
North East (NE)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
North East (NE)	0.9 x	4.7	98.85	0.7	0.8	0.9	210.73	
						Total	210.73	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	251.38	241.54	247.39	
Total summer gains	478.88	452.27	419.8	**(P5)**
Summer gain/loss ratio	3.62	3.42	3.18	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	0.25	0.25	0.25	
Threshold temperature	19.87	21.57	21.23	**(P7)**
Likelihood of high internal temperature	**Not significant**	**Slight**	**Slight**	

Assessment of likelihood of high internal temperature: Slight

APPENDIX B – SAP RESULTS

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name: | **Stroma Number:**
Software Name: Stroma FSAP 2012 | **Software Version:** Version: 1.0.4.6

Property Address: Flat 2

Address :

1. Overall dwelling dimensions:

	Area(m²)			Av. Height(m)			Volume(m³)	
Basement	21.93	(1a)	x	2.63	(2a)	=	57.67	(3a)
Ground floor	21.93	(1b)	x	3.23	(2b)	=	70.83	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	43.86	(4)						
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)		=	128.5	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

DRAFT

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.16	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.66	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.56	(21)

Infiltration rate modified for monthly wind speed

Monthly average wind speed from Table 7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.71	0.7	0.68	0.61	0.6	0.53	0.53	0.52	0.56	0.6	0.63	0.65

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.71	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.75	0.74	0.73	0.69	0.68	0.64	0.64	0.63	0.66	0.68	0.7	0.71	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			2.4		x1/[1/(1.6)+ 0.04]	=	3.61			(27)
Windows Type 2			6		x1/[1/(1.6)+ 0.04]	=	9.02			(27)
Windows Type 3			3.8		x1/[1/(1.6)+ 0.04]	=	5.71			(27)
Floor			21.928	x	0.25	=	5.482			(28)
Walls Type1	15.52	3.8	11.72	x	0.3	=	3.52			(29)
Walls Type2	17.83	10.4	7.43	x	0.3	=	2.23			(29)
Walls Type3	2.93	0	2.93	x	0.27	=	0.78			(29)
Total area of elements, m²			58.21							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	33.35	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		8.73	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	42.08	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	31.91	31.49	31.08	29.17	28.81	27.15	27.15	26.84	27.79	28.81	29.54	30.29	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	73.99	73.58	73.17	71.25	70.9	69.23	69.23	68.92	69.87	70.9	71.62	72.38	

Average = $Sum(39)_{1…12}$ /12= 71.25 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.69	1.68	1.67	1.62	1.62	1.58	1.58	1.57	1.59	1.62	1.63	1.65	

Average = $Sum(40)_{1…12}$ /12= 1.62 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.51 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 70.11 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

(44)m=	77.13	74.32	71.52	68.71	65.91	63.1	63.1	65.91	68.71	71.52	74.32	77.13	

Total = $Sum(44)_{1…12}$ = 841.37 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	114.37	100.03	103.23	89.99	86.35	74.51	69.05	79.23	80.18	93.44	102	110.77	

Total = $Sum(45)_{1…12}$ = 1103.17 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	17.16	15	15.48	13.5	12.95	11.18	10.36	11.89	12.03	14.02	15.3	16.61	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	39.3	34.21	36.44	33.89	33.59	31.12	32.16	33.59	33.89	36.44	36.65	39.3	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	153.68	134.24	139.67	123.88	119.94	105.63	101.21	112.82	114.07	129.89	138.65	150.07	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	153.68	134.24	139.67	123.88	119.94	105.63	101.21	112.82	114.07	129.89	138.65	150.07

Output from water heater (annual)$_{1...12}$ — 1523.74 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	47.86	41.81	43.43	38.39	37.11	32.56	31	34.74	35.13	40.18	43.08	46.66	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	90.73	90.73	90.73	90.73	90.73	90.73	90.73	90.73	90.73	90.73	90.73	90.73	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	29.27	26	21.14	16.01	11.97	10.1	10.92	14.19	19.04	24.18	28.22	30.09	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	196.03	198.06	192.94	182.02	168.25	155.3	146.65	144.62	149.74	160.66	174.43	187.38	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	45.59	45.59	45.59	45.59	45.59	45.59	45.59	45.59	45.59	45.59	45.59	45.59	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	-60.49	(71)

Water heating gains (Table 5)

(72)m=	64.32	62.22	58.38	53.33	49.88	45.22	41.66	46.7	48.79	54.01	59.83	62.71	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	368.45	365.11	351.29	330.18	308.92	289.45	278.06	284.33	296.41	317.67	341.31	359	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)

Southeast	0.9x	0.77	x	6	x	36.79	x	0.7	x	0.8	=	85.67	(77)
Southeast	0.9x	0.77	x	6	x	62.67	x	0.7	x	0.8	=	145.93	(77)
Southeast	0.9x	0.77	x	6	x	85.75	x	0.7	x	0.8	=	199.67	(77)
Southeast	0.9x	0.77	x	6	x	106.25	x	0.7	x	0.8	=	247.4	(77)
Southeast	0.9x	0.77	x	6	x	119.01	x	0.7	x	0.8	=	277.11	(77)
Southeast	0.9x	0.77	x	6	x	118.15	x	0.7	x	0.8	=	275.11	(77)
Southeast	0.9x	0.77	x	6	x	113.91	x	0.7	x	0.8	=	265.24	(77)
Southeast	0.9x	0.77	x	6	x	104.39	x	0.7	x	0.8	=	243.07	(77)
Southeast	0.9x	0.77	x	6	x	92.85	x	0.7	x	0.8	=	216.2	(77)
Southeast	0.9x	0.77	x	6	x	69.27	x	0.7	x	0.8	=	161.29	(77)
Southeast	0.9x	0.77	x	6	x	44.07	x	0.7	x	0.8	=	102.62	(77)
Southeast	0.9x	0.77	x	6	x	31.49	x	0.7	x	0.8	=	73.32	(77)
Northwest	0.9x	0.77	x	2.4	x	11.28	x	0.7	x	0.8	=	10.51	(81)
Northwest	0.9x	0.77	x	3.8	x	11.28	x	0.7	x	0.8	=	16.64	(81)
Northwest	0.9x	0.77	x	2.4	x	22.97	x	0.7	x	0.8	=	21.39	(81)
Northwest	0.9x	0.77	x	3.8	x	22.97	x	0.7	x	0.8	=	33.87	(81)
Northwest	0.9x	0.77	x	2.4	x	41.38	x	0.7	x	0.8	=	38.54	(81)
Northwest	0.9x	0.77	x	3.8	x	41.38	x	0.7	x	0.8	=	61.02	(81)
Northwest	0.9x	0.77	x	2.4	x	67.96	x	0.7	x	0.8	=	63.29	(81)
Northwest	0.9x	0.77	x	3.8	x	67.96	x	0.7	x	0.8	=	100.21	(81)
Northwest	0.9x	0.77	x	2.4	x	91.35	x	0.7	x	0.8	=	85.08	(81)
Northwest	0.9x	0.77	x	3.8	x	91.35	x	0.7	x	0.8	=	134.71	(81)
Northwest	0.9x	0.77	x	2.4	x	97.38	x	0.7	x	0.8	=	90.7	(81)
Northwest	0.9x	0.77	x	3.8	x	97.38	x	0.7	x	0.8	=	143.61	(81)
Northwest	0.9x	0.77	x	2.4	x	91.1	x	0.7	x	0.8	=	84.85	(81)
Northwest	0.9x	0.77	x	3.8	x	91.1	x	0.7	x	0.8	=	134.35	(81)
Northwest	0.9x	0.77	x	2.4	x	72.63	x	0.7	x	0.8	=	67.64	(81)
Northwest	0.9x	0.77	x	3.8	x	72.63	x	0.7	x	0.8	=	107.1	(81)
Northwest	0.9x	0.77	x	2.4	x	50.42	x	0.7	x	0.8	=	46.96	(81)
Northwest	0.9x	0.77	x	3.8	x	50.42	x	0.7	x	0.8	=	74.36	(81)
Northwest	0.9x	0.77	x	2.4	x	28.07	x	0.7	x	0.8	=	26.14	(81)
Northwest	0.9x	0.77	x	3.8	x	28.07	x	0.7	x	0.8	=	41.39	(81)
Northwest	0.9x	0.77	x	2.4	x	14.2	x	0.7	x	0.8	=	13.22	(81)
Northwest	0.9x	0.77	x	3.8	x	14.2	x	0.7	x	0.8	=	20.94	(81)
Northwest	0.9x	0.77	x	2.4	x	9.21	x	0.7	x	0.8	=	8.58	(81)
Northwest	0.9x	0.77	x	3.8	x	9.21	x	0.7	x	0.8	=	13.59	(81)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	112.82	201.19	299.23	410.91	496.9	509.43	484.43	417.82	337.52	228.82	136.78	95.49	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	481.27	566.31	650.52	741.1	805.82	798.87	762.49	702.15	633.93	546.49	478.09	454.49	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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(86)m=	0.98	0.97	0.93	0.85	0.71	0.53	0.39	0.44	0.68	0.89	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.81	19.99	20.26	20.59	20.8	20.9	20.92	20.92	20.85	20.56	20.14	19.8	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.55	19.56	19.56	19.6	19.6	19.63	19.63	19.63	19.62	19.6	19.59	19.58	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.91	0.8	0.63	0.43	0.27	0.32	0.57	0.85	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.03	18.3	18.68	19.13	19.39	19.51	19.53	19.53	19.47	19.12	18.54	18.03	(90)

fLA = Living area ÷ (4) = 0.5 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.92	19.15	19.47	19.86	20.09	20.21	20.23	20.23	20.16	19.84	19.34	18.92	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.92	19.15	19.47	19.86	20.09	20.21	20.23	20.23	20.16	19.84	19.34	18.92	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.95	0.91	0.81	0.66	0.47	0.33	0.37	0.61	0.86	0.95	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	468.12	539.14	591.63	603.28	532.54	376.1	248.82	260.15	389.6	469.78	455.65	444.12	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1081.91	1048.2	948.98	780.91	595.1	388.11	250.96	263.63	423.29	655.26	876.73	1065.1	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	456.66	342.09	265.86	127.9	46.54	0	0	0	0	138	303.18	462.01	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 2142.25 (98)

Space heating requirement in kWh/m²/year 48.85 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	456.66	342.09	265.86	127.9	46.54	0	0	0	0	138	303.18	462.01	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	492.09	368.63	286.49	137.82	50.16	0	0	0	0	148.71	326.71	497.85	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 2308.46 (211)

Space heating fuel (secondary), kWh/month
= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

Output from water heater (calculated above)

	153.68	134.24	139.67	123.88	119.94	105.63	101.21	112.82	114.07	129.89	138.65	150.07		
Efficiency of water heater													83.5	(216)
(217)m=	90.27	89.98	89.37	87.98	85.91	83.5	83.5	83.5	83.5	88.05	89.67	90.33		(217)

Fuel for water heating, kWh/month
(219)m = (64)m x 100 ÷ (217)m

(219)m=	170.24	149.2	156.28	140.81	139.61	126.51	121.2	135.11	136.61	147.52	154.63	166.13		
Total = Sum(219a)$_{1...12}$ =													1743.85	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			2308.46	
Water heating fuel used			1743.85	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			206.78	(232)
Electricity generated by PVs			-482.91	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	80.33	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	60.69	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	27.27	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-63.7	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	228.56	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.08	(257)
SAP rating (Section 12)		84.93	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	498.63	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	376.67	(264)
Space and water heating	(261) + (262) + (263) + (264) =				875.3	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	107.32	(268)
Energy saving/generation technologies Item 1			0.519	=	-250.63	(269)
Total CO2, kg/year			sum of (265)…(271) =		747.56	(272)
CO2 emissions per m²			(272) ÷ (4) =		17.05	(273)
EI rating (section 14)					89	(274)

13a. Primary Energy

	Energy kWh/year		Primary factor		P. Energy kWh/year	
Space heating (main system 1)	(211)	x	1.22	=	2816.32	(261)
Space heating (secondary)	(215)	x	3.07	=	0	(263)
Energy for water heating	(219)	x	1.22	=	2127.5	(264)
Space and water heating	(261) + (262) + (263) + (264) =				4943.83	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	3.07	=	92.1	(267)
Electricity for lighting	(232)	x	0	=	634.82	(268)
Energy saving/generation technologies Item 1			3.07	=	-1482.54	(269)
'Total Primary Energy			sum of (265)…(271) =		4188.21	(272)
Primary energy kWh/m²/year			(272) ÷ (4) =		95.5	(273)

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User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 4

Address :

1. Overall dwelling dimensions:

	Area(m²)			**Av. Height(m)**			**Volume(m³)**	
Basement	21.13	(1a)	x	2.63	(2a)	=	55.58	(3a)
Ground floor	17.83	(1b)	x	3.23	(2b)	=	57.58	(3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	38.96	(4)						
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	=	113.16	(5)

2. Ventilation rate:

	main heating		**secondary heating**		**other**		**total**		**m³ per hour**	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues and fans =	(6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.18	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.68	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.58	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7

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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.73	0.72	0.7	0.63	0.62	0.55	0.55	0.53	0.58	0.62	0.65	0.68

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.77	0.76	0.75	0.7	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.77	0.76	0.75	0.7	0.69	0.65	0.65	0.64	0.67	0.69	0.71	0.73	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			4.6	x1/[1/(1.6)+ 0.04]		=	6.92			(27)
Windows Type 2			3.1	x1/[1/(1.6)+ 0.04]		=	4.66			(27)
Windows Type 3			2.3	x1/[1/(1.6)+ 0.04]		=	3.46			(27)
Floor Type 1			21.132	x	0.25	=	5.283			(28)
Floor Type 2			3.304	x	0.3	=	0.9912			(28)
Walls Type1	10.94	0	10.94	x	0.3	=	3.28			(29)
Walls Type2	14.56	10	4.56	x	0.3	=	1.37			(29)
Walls Type3	25.06	2	23.06	x	0.27	=	6.13			(29)
Walls Type4	22.91	0	22.91	x	0.3	=	6.87			(29)
Total area of elements, m²			97.91							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 41.96 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

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Thermal bridges : S (L x Y) calculated using Appendix K | 14.69 | (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = | 56.65 | (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	28.72	28.33	27.94	26.15	25.81	24.25	24.25	23.96	24.85	25.81	26.49	27.2	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	85.36	84.97	84.59	82.8	82.46	80.9	80.9	80.61	81.5	82.46	83.14	83.85	

Average = $Sum(39)_{1...12}$ /12= | 82.8 | (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	2.19	2.18	2.17	2.13	2.12	2.08	2.08	2.07	2.09	2.12	2.13	2.15	

Average = $Sum(40)_{1...12}$ /12= | 2.13 | (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N | 1.38 | (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 | 66.95 | (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	73.65	70.97	68.29	65.61	62.93	60.26	60.26	62.93	65.61	68.29	70.97	73.65	

Total = $Sum(44)_{1...12}$ = | 803.41 | (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	109.21	95.52	98.57	85.93	82.46	71.15	65.93	75.66	76.56	89.23	97.4	105.77	

Total = $Sum(45)_{1...12}$ = | 1053.4 | (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	16.38	14.33	14.79	12.89	12.37	10.67	9.89	11.35	11.48	13.38	14.61	15.87	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel | 0 | (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): | 0 | (48)

Temperature factor from Table 2b | 0 | (49)

Energy lost from water storage, kWh/year (48) x (49) = | 0 | (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) | 0 | (51)

If community heating see section 4.3

Volume factor from Table 2a | 0 | (52)

Temperature factor from Table 2b | 0 | (53)

Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)
Enter (50) or (54) in (55)		0	(55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	37.53	32.66	34.8	32.36	32.07	29.72	30.71	32.07	32.36	34.8	35	37.53	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	146.74	128.18	133.37	118.29	114.53	100.87	96.64	107.73	108.92	124.03	132.4	143.3	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	146.74	128.18	133.37	118.29	114.53	100.87	96.64	107.73	108.92	124.03	132.4	143.3	

Output from water heater (annual)$_{1...12}$ — 1454.99 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	45.7	39.93	41.47	36.66	35.43	31.09	29.6	33.17	33.55	38.37	41.13	44.55	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	82.74	82.74	82.74	82.74	82.74	82.74	82.74	82.74	82.74	82.74	82.74	82.74	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	26.51	23.54	19.15	14.49	10.84	9.15	9.88	12.85	17.24	21.9	25.56	27.24	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	177.5	179.34	174.7	164.82	152.35	140.63	132.79	130.95	135.59	145.47	157.95	169.67	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	44.65	44.65	44.65	44.65	44.65	44.65	44.65	44.65	44.65	44.65	44.65	44.65	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	-55.16	(71)

Water heating gains (Table 5)

(72)m=	61.42	59.41	55.74	50.92	47.63	43.18	39.78	44.59	46.59	51.57	57.13	59.88	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	340.66	337.53	324.83	305.47	286.04	268.18	257.69	263.62	274.66	294.17	315.87	332.03	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

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Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	3.1	x	11.28	x	0.7	x	0.8	=	13.57	(75)
Northeast	0.9x	0.77	x	2.3	x	11.28	x	0.7	x	0.8	=	10.07	(75)
Northeast	0.9x	0.77	x	3.1	x	22.97	x	0.7	x	0.8	=	27.63	(75)
Northeast	0.9x	0.77	x	2.3	x	22.97	x	0.7	x	0.8	=	20.5	(75)
Northeast	0.9x	0.77	x	3.1	x	41.38	x	0.7	x	0.8	=	49.78	(75)
Northeast	0.9x	0.77	x	2.3	x	41.38	x	0.7	x	0.8	=	36.93	(75)
Northeast	0.9x	0.77	x	3.1	x	67.96	x	0.7	x	0.8	=	81.75	(75)
Northeast	0.9x	0.77	x	2.3	x	67.96	x	0.7	x	0.8	=	60.66	(75)
Northeast	0.9x	0.77	x	3.1	x	91.35	x	0.7	x	0.8	=	109.89	(75)
Northeast	0.9x	0.77	x	2.3	x	91.35	x	0.7	x	0.8	=	81.53	(75)
Northeast	0.9x	0.77	x	3.1	x	97.38	x	0.7	x	0.8	=	117.16	(75)
Northeast	0.9x	0.77	x	2.3	x	97.38	x	0.7	x	0.8	=	86.92	(75)
Northeast	0.9x	0.77	x	3.1	x	91.1	x	0.7	x	0.8	=	109.6	(75)
Northeast	0.9x	0.77	x	2.3	x	91.1	x	0.7	x	0.8	=	81.32	(75)
Northeast	0.9x	0.77	x	3.1	x	72.63	x	0.7	x	0.8	=	87.37	(75)
Northeast	0.9x	0.77	x	2.3	x	72.63	x	0.7	x	0.8	=	64.83	(75)
Northeast	0.9x	0.77	x	3.1	x	50.42	x	0.7	x	0.8	=	60.66	(75)
Northeast	0.9x	0.77	x	2.3	x	50.42	x	0.7	x	0.8	=	45	(75)
Northeast	0.9x	0.77	x	3.1	x	28.07	x	0.7	x	0.8	=	33.77	(75)
Northeast	0.9x	0.77	x	2.3	x	28.07	x	0.7	x	0.8	=	25.05	(75)
Northeast	0.9x	0.77	x	3.1	x	14.2	x	0.7	x	0.8	=	17.08	(75)
Northeast	0.9x	0.77	x	2.3	x	14.2	x	0.7	x	0.8	=	12.67	(75)
Northeast	0.9x	0.77	x	3.1	x	9.21	x	0.7	x	0.8	=	11.09	(75)
Northeast	0.9x	0.77	x	2.3	x	9.21	x	0.7	x	0.8	=	8.22	(75)
Southeast	0.9x	0.77	x	4.6	x	36.79	x	0.7	x	0.8	=	65.68	(77)
Southeast	0.9x	0.77	x	4.6	x	62.67	x	0.7	x	0.8	=	111.88	(77)
Southeast	0.9x	0.77	x	4.6	x	85.75	x	0.7	x	0.8	=	153.08	(77)
Southeast	0.9x	0.77	x	4.6	x	106.25	x	0.7	x	0.8	=	189.68	(77)
Southeast	0.9x	0.77	x	4.6	x	119.01	x	0.7	x	0.8	=	212.45	(77)
Southeast	0.9x	0.77	x	4.6	x	118.15	x	0.7	x	0.8	=	210.92	(77)
Southeast	0.9x	0.77	x	4.6	x	113.91	x	0.7	x	0.8	=	203.35	(77)
Southeast	0.9x	0.77	x	4.6	x	104.39	x	0.7	x	0.8	=	186.35	(77)
Southeast	0.9x	0.77	x	4.6	x	92.85	x	0.7	x	0.8	=	165.76	(77)
Southeast	0.9x	0.77	x	4.6	x	69.27	x	0.7	x	0.8	=	123.65	(77)
Southeast	0.9x	0.77	x	4.6	x	44.07	x	0.7	x	0.8	=	78.67	(77)
Southeast	0.9x	0.77	x	4.6	x	31.49	x	0.7	x	0.8	=	56.21	(77)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	89.33	160.01	239.8	332.09	403.88	415	394.26	338.55	271.42	182.47	108.42	75.52	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	429.99	497.55	564.62	637.56	689.92	683.18	651.96	602.17	546.08	476.64	424.29	407.55	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.95	0.9	0.8	0.65	0.51	0.56	0.77	0.93	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.39	19.57	19.86	20.26	20.58	20.8	20.88	20.86	20.7	20.28	19.78	19.37	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.21	19.22	19.22	19.25	19.26	19.28	19.28	19.29	19.27	19.26	19.25	19.23	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.93	0.86	0.72	0.51	0.33	0.38	0.66	0.89	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.18	17.45	17.87	18.43	18.85	19.1	19.15	19.15	19.01	18.48	17.77	17.18	(90)

fLA = Living area ÷ (4) = | 0.46 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.19	18.42	18.78	19.27	19.64	19.88	19.94	19.93	19.78	19.3	18.69	18.18	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.19	18.42	18.78	19.27	19.64	19.88	19.94	19.93	19.78	19.3	18.69	18.18	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.97	0.96	0.93	0.86	0.74	0.57	0.4	0.45	0.7	0.89	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	418.16	476.18	523.1	547.96	511.3	386.32	260.87	271.03	380.33	423.63	406.05	397.91	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1186.02	1148.56	1038.85	858.31	655.06	426.98	270.31	284.93	463.09	717.45	963.43	1172.64	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	571.29	451.84	383.72	223.46	106.96	0	0	0	0	218.61	401.32	576.4	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = | 2933.59 | (98)

Space heating requirement in kWh/m²/year | 75.3 | (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	571.29	451.84	383.72	223.46	106.96	0	0	0	0	218.61	401.32	576.4		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	615.61	486.9	413.49	240.79	115.26	0	0	0	0	235.57	432.46	621.12		
Total (kWh/year) =Sum(211)$_{1...5,10....12}$=													3161.19	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10....12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	146.74	128.18	133.37	118.29	114.53	100.87	96.64	107.73	108.92	124.03	132.4	143.3		
Efficiency of water heater													83.5	(216)
(217)m=	90.73	90.57	90.21	89.36	87.75	83.5	83.5	83.5	83.5	89.2	90.3	90.79		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	161.73	141.53	147.84	132.38	130.52	120.8	115.74	129.02	130.44	139.04	146.61	157.84		
Total = Sum(219a)$_{1...12}$ =													1653.49	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			3161.19	
Water heating fuel used			1653.49	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			187.24	(232)
Electricity generated by PVs			-428.92	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	110.01	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	57.54	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	24.7	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-56.57	(252)
Appendix Q items: repeat lines (253) and (254) as needed					
Total energy cost	(245)...(247) + (250)…(254) =			259.63	(255)

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11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.3	(257)
SAP rating (Section 12)		81.88	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	682.82	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	357.15	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1039.97	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	97.18	(268)
Energy saving/generation technologies Item 1		0.519	=	-222.61	(269)
Total CO2, kg/year		sum of (265)…(271) =		930.11	(272)
CO2 emissions per m²		(272) ÷ (4) =		23.87	(273)
El rating (section 14)				85	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	3856.66	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2017.25	(264)
Space and water heating	(261) + (262) + (263) + (264) =			5873.91	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	574.83	(268)
Energy saving/generation technologies Item 1		3.07	=	-1316.78	(269)
'Total Primary Energy		sum of (265)…(271) =		5224.07	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		134.09	(273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.6

Property Address: Plot 6

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	70.98	(1a) x	3.47	(2a) =	246.39	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.98	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	246.39	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 ÷ (5) =	0.08	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.58	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.49	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.63	0.62	0.61	0.54	0.53	0.47	0.47	0.46	0.49	0.53	0.56	0.58

Calculate effective air change rate for the applicable case

If mechanical ventilation:	0	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a)	0	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0	(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.7	0.69	0.68	0.65	0.64	0.61	0.61	0.6	0.62	0.64	0.65	0.67	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.7	0.69	0.68	0.65	0.64	0.61	0.61	0.6	0.62	0.64	0.65	0.67	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			5.4	x1/[1/(1.6)+ 0.04]		=	8.12			(27)
Windows Type 2			3.2	x1/[1/(1.6)+ 0.04]		=	4.81			(27)
Windows Type 3			1.5	x1/[1/(1.6)+ 0.04]		=	2.26			(27)
Floor Type 1			66.599	x	0.25	=	16.64975			(28)
Floor Type 2			4.385	x	0.3	=	1.3155			(28)
Walls Type1	38.74	10.1	28.64	x	0.3	=	8.59			(29)
Walls Type2	6.43	2	4.43	x	0.27	=	1.19			(29)
Total area of elements, m²			116.16							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U)	(26)…(30) + (32) =	45.93	(33)
Heat capacity Cm = S(A x k)	((28)…(30) + (32) + (32a)…(32e) =	0	(34)
Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K	Indicative Value: Medium	250	(35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K		17.42	(36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss	(33) + (36) =	63.36	(37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	56.78	56.15	55.54	52.66	52.12	49.61	49.61	49.14	50.57	52.12	53.21	54.35	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	120.14	119.51	118.9	116.01	115.47	112.96	112.96	112.5	113.93	115.47	116.57	117.71	

Average = Sum(39)1…12 /12= 116.01 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.69	1.68	1.67	1.63	1.63	1.59	1.59	1.58	1.61	1.63	1.64	1.66

Average = Sum(40)$_{1…12}$ /12= 1.63 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 2.27 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.11 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	96.92	93.39	89.87	86.35	82.82	79.3	79.3	82.82	86.35	89.87	93.39	96.92	
											Total = Sum(44)$_{1…12}$ =	1057.29	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	143.73	125.7	129.72	113.09	108.51	93.64	86.77	99.57	100.76	117.42	128.18	139.19	
											Total = Sum(45)$_{1…12}$ =	1386.27	(45)
If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)													
(46)m=	21.56	18.86	19.46	16.96	16.28	14.05	13.02	14.94	15.11	17.61	19.23	20.88	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	49.39	42.99	45.8	42.58	42.2	39.11	40.41	42.2	42.58	45.8	46.06	49.39	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	193.11	168.69	175.51	155.67	150.72	132.74	127.18	141.77	143.34	163.22	174.23	188.58	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	193.11	168.69	175.51	155.67	150.72	132.74	127.18	141.77	143.34	163.22	174.23	188.58	

Output from water heater (annual)$_{1...12}$ 1914.77 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	60.14	52.54	54.58	48.25	46.63	40.91	38.95	43.66	44.15	50.49	54.13	58.63	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	136.19	136.19	136.19	136.19	136.19	136.19	136.19	136.19	136.19	136.19	136.19	136.19	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	46.26	41.09	33.42	25.3	18.91	15.96	17.25	22.42	30.1	38.21	44.6	47.55	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	297.88	300.98	293.19	276.6	255.67	236	222.85	219.76	227.55	244.13	265.07	284.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	50.89	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	-90.79	(71)
Water heating gains (Table 5)													
(72)m=	80.83	78.19	73.36	67.01	62.68	56.82	52.36	58.68	61.32	67.87	75.18	78.8	(72)
Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	524.26	519.54	499.25	468.2	436.54	408.07	391.74	400.15	418.25	449.5	484.14	510.37	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast 0.9x	0.77	x	5.4	x	11.28	x	0.7	x	0.8	=	23.64	(75)
Northeast 0.9x	0.77	x	5.4	x	22.97	x	0.7	x	0.8	=	48.13	(75)
Northeast 0.9x	0.77	x	5.4	x	41.38	x	0.7	x	0.8	=	86.71	(75)
Northeast 0.9x	0.77	x	5.4	x	67.96	x	0.7	x	0.8	=	142.41	(75)
Northeast 0.9x	0.77	x	5.4	x	91.35	x	0.7	x	0.8	=	191.43	(75)

Northeast	0.9x	0.77	x	5.4	x	97.38	x	0.7	x	0.8	=	204.08	(75)
Northeast	0.9x	0.77	x	5.4	x	91.1	x	0.7	x	0.8	=	190.91	(75)
Northeast	0.9x	0.77	x	5.4	x	72.63	x	0.7	x	0.8	=	152.2	(75)
Northeast	0.9x	0.77	x	5.4	x	50.42	x	0.7	x	0.8	=	105.66	(75)
Northeast	0.9x	0.77	x	5.4	x	28.07	x	0.7	x	0.8	=	58.82	(75)
Northeast	0.9x	0.77	x	5.4	x	14.2	x	0.7	x	0.8	=	29.75	(75)
Northeast	0.9x	0.77	x	5.4	x	9.21	x	0.7	x	0.8	=	19.31	(75)
Southeast	0.9x	0.77	x	1.5	x	36.79	x	0.7	x	0.8	=	21.42	(77)
Southeast	0.9x	0.77	x	1.5	x	62.67	x	0.7	x	0.8	=	36.48	(77)
Southeast	0.9x	0.77	x	1.5	x	85.75	x	0.7	x	0.8	=	49.92	(77)
Southeast	0.9x	0.77	x	1.5	x	106.25	x	0.7	x	0.8	=	61.85	(77)
Southeast	0.9x	0.77	x	1.5	x	119.01	x	0.7	x	0.8	=	69.28	(77)
Southeast	0.9x	0.77	x	1.5	x	118.15	x	0.7	x	0.8	=	68.78	(77)
Southeast	0.9x	0.77	x	1.5	x	113.91	x	0.7	x	0.8	=	66.31	(77)
Southeast	0.9x	0.77	x	1.5	x	104.39	x	0.7	x	0.8	=	60.77	(77)
Southeast	0.9x	0.77	x	1.5	x	92.85	x	0.7	x	0.8	=	54.05	(77)
Southeast	0.9x	0.77	x	1.5	x	69.27	x	0.7	x	0.8	=	40.32	(77)
Southeast	0.9x	0.77	x	1.5	x	44.07	x	0.7	x	0.8	=	25.65	(77)
Southeast	0.9x	0.77	x	1.5	x	31.49	x	0.7	x	0.8	=	18.33	(77)
Southwest	0.9x	0.77	x	3.2	x	36.79		0.7	x	0.8	=	45.69	(79)
Southwest	0.9x	0.77	x	3.2	x	62.67		0.7	x	0.8	=	77.83	(79)
Southwest	0.9x	0.77	x	3.2	x	85.75		0.7	x	0.8	=	106.49	(79)
Southwest	0.9x	0.77	x	3.2	x	106.25		0.7	x	0.8	=	131.95	(79)
Southwest	0.9x	0.77	x	3.2	x	119.01		0.7	x	0.8	=	147.79	(79)
Southwest	0.9x	0.77	x	3.2	x	118.15		0.7	x	0.8	=	146.73	(79)
Southwest	0.9x	0.77	x	3.2	x	113.91		0.7	x	0.8	=	141.46	(79)
Southwest	0.9x	0.77	x	3.2	x	104.39		0.7	x	0.8	=	129.64	(79)
Southwest	0.9x	0.77	x	3.2	x	92.85		0.7	x	0.8	=	115.31	(79)
Southwest	0.9x	0.77	x	3.2	x	69.27		0.7	x	0.8	=	86.02	(79)
Southwest	0.9x	0.77	x	3.2	x	44.07		0.7	x	0.8	=	54.73	(79)
Southwest	0.9x	0.77	x	3.2	x	31.49		0.7	x	0.8	=	39.1	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	90.76	162.44	243.13	336.21	408.5	419.58	398.68	342.6	275.02	185.16	110.13	76.74	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	615.01	681.98	742.37	804.41	845.04	827.65	790.43	742.75	693.27	634.66	594.27	587.12	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.88	0.74	0.59	0.64	0.84	0.96	0.99	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.67	19.8	20.02	20.34	20.63	20.83	20.9	20.89	20.74	20.39	19.99	19.66	(87)

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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.55	19.55	19.56	19.59	19.59	19.62	19.62	19.62	19.61	19.59	19.58	19.57	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.92	0.82	0.63	0.42	0.47	0.75	0.94	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.82	18.01	18.35	18.82	19.2	19.45	19.51	19.51	19.37	18.9	18.32	17.83	(90)

fLA = Living area ÷ (4) = 0.3 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.37	18.55	18.85	19.28	19.63	19.86	19.92	19.92	19.78	19.34	18.82	18.38	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.37	18.55	18.85	19.28	19.63	19.86	19.92	19.92	19.78	19.34	18.82	18.38	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.99	0.98	0.96	0.92	0.82	0.65	0.46	0.51	0.77	0.93	0.98	0.99	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	605.99	666.65	713.05	738.02	696.41	537.43	364.52	379.64	531.7	590.45	580.02	579.83	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	1690.75	1631.01	1468.06	1203.8	915.4	594.72	375.55	396.1	647	1009.5	1365.6	1669.11	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	807.06	648.05	561.73	335.36	162.93	0	0	0	0	311.77	565.62	810.43	

Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ = 4202.95 (98)

Space heating requirement in kWh/m²/year 59.21 (99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
Space heating requirement (calculated above)													
	807.06	648.05	561.73	335.36	162.93	0	0	0	0	311.77	565.62	810.43	
(211)m = {[(98)m x (204)] } x 100 ÷ (206)													(211)
	869.68	698.33	605.31	361.38	175.57	0	0	0	0	335.96	609.5	873.31	

Total (kWh/year) =Sum(211)$_{1...5,10...12}$= 4529.04 (211)

Space heating fuel (secondary), kWh/month

= {[(98)m x (201)] } x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	0

Total (kWh/year) =Sum(215)$_{1...5,10...12}$= 0 (215)

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Water heating

Output from water heater (calculated above)

193.11	168.69	175.51	155.67	150.72	132.74	127.18	141.77	143.34	163.22	174.23	188.58

Efficiency of water heater: 83.5 (216)

(217)m=	90.85	90.71	90.4	89.64	88.09	83.5	83.5	83.5	83.5	89.38	90.43	90.89	(217)

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	212.57	185.96	194.14	173.67	171.1	158.97	152.31	169.79	171.66	182.61	192.68	207.48

Total = Sum(219a)$_{1...12}$ = 2172.96 (219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			4529.04	
Water heating fuel used			2172.96	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			326.79	(232)
Electricity generated by PVs			-781.79	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year	**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211) x	3.48	x 0.01 =	157.61	(240)
Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	75.62	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a					
Energy for lighting	(232)	13.19	x 0.01 =	43.1	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-103.12	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost (245)...(247) + (250)…(254) = 297.17 (255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.08	(257)
SAP rating (Section 12)		84.99	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

Energy kWh/year	**Emission factor** kg CO2/kWh	**Emissions** kg CO2/year

Space heating (main system 1)	(211) x	0.216	=	978.27	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	469.36	(264)
Space and water heating	(261) + (262) + (263) + (264) =			1447.63	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	169.61	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-405.75	(269)
Total CO2, kg/year		sum of (265)…(271) =		1227.06	(272)
CO2 emissions per m²		(272) ÷ (4) =		17.29	(273)
EI rating (section 14)				86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	5525.43	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2651.01	(264)
Space and water heating	(261) + (262) + (263) + (264) =			8176.43	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	1003.25	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-2400.08	(269)
‘Total Primary Energy		sum of (265)…(271) =		6871.7	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		96.81	(273)

SAP WorkSheet: New dwelling design stage

User Details:

Assessor Name:		**Stroma Number:**	
Software Name:	Stroma FSAP 2012	**Software Version:**	Version: 1.0.4.6

Property Address: Plot 8

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	56.24	(1a) x	3.47	(2a) =	195.21	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	56.24	(4)				
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =		195.21	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.1	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction *if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35*		0	(11)
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.6	(18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.51	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.65	0.64	0.63	0.56	0.55	0.49	0.49	0.47	0.51	0.55	0.58	0.6

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside
if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft
if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.71	0.7	0.7	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.67	0.68	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.71	0.7	0.7	0.66	0.65	0.62	0.62	0.61	0.63	0.65	0.67	0.68	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows Type 1			3.6	x1/[1/(1.6)+ 0.04]		=	5.41			(27)
Windows Type 2			1.4	x1/[1/(1.6)+ 0.04]		=	2.11			(27)
Walls Type1	24.87	0	24.87	x	0.3	=	7.46			(29)
Walls Type2	29.46	5	24.46	x	0.28	=	6.85			(29)
Walls Type3	43.11	2	41.11	x	0.27	=	11.01			(29)
Total area of elements, m²			97.44							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*
*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 35.84 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 14.62 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 50.46 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	45.94	45.41	44.88	42.43	41.97	39.83	39.83	39.44	40.66	41.97	42.9	43.87	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	96.4	95.86	95.34	92.89	92.43	90.29	90.29	89.89	91.11	92.43	93.36	94.33	

Average = $Sum(39)_{1…12}$ /12= 92.88 (39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(40)m=	1.71	1.7	1.7	1.65	1.64	1.61	1.61	1.6	1.62	1.64	1.66	1.68		
											Average = Sum(40)1…12 /12=		1.65	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N — 1.87 (42)
if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)
if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 — 78.7 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(44)m=	86.57	83.42	80.27	77.12	73.98	70.83	70.83	73.98	77.12	80.27	83.42	86.57		
											Total = Sum(44)1…12 =		944.36	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
(45)m=	128.38	112.28	115.86	101.01	96.92	83.64	77.5	88.93	90	104.88	114.49	124.33		
											Total = Sum(45)1…12 =		1238.21	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	19.26	16.84	17.38	15.15	14.54	12.55	11.63	13.34	13.5	15.73	17.17	18.65	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel — 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): — 0 (48)

Temperature factor from Table 2b — 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = — 0 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) — 0 (51)

If community heating see section 4.3

Volume factor from Table 2a — 0 (52)

Temperature factor from Table 2b — 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = — 0 (54)

Enter (50) or (54) in (55) — 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 — 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	44.11	38.4	40.91	38.03	37.7	34.93	36.09	37.7	38.03	40.91	41.14	44.11	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	172.49	150.67	156.77	139.04	134.62	118.56	113.59	126.63	128.03	145.79	155.62	168.44	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	172.49	150.67	156.77	139.04	134.62	118.56	113.59	126.63	128.03	145.79	155.62	168.44

Output from water heater (annual)$_{1...12}$ | 1710.26 | (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	53.71	46.93	48.75	43.09	41.65	36.54	34.79	38.99	39.43	45.1	48.35	52.37	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	112.41	112.41	112.41	112.41	112.41	112.41	112.41	112.41	112.41	112.41	112.41	112.41	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	41.9	37.22	30.27	22.92	17.13	14.46	15.63	20.31	27.26	34.62	40.4	43.07	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	243.84	246.37	239.99	226.42	209.28	193.18	182.42	179.89	186.27	199.84	216.98	233.08	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	48.11	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	-74.94	(71)

Water heating gains (Table 5)

(72)m=	72.2	69.84	65.52	59.85	55.98	50.75	46.76	52.41	54.77	60.62	67.15	70.39	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	446.53	442.01	424.37	397.77	370.98	346.98	333.4	341.2	356.88	383.66	413.12	435.12	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Southeast	0.9x	0.77	x	3.6	x	36.79	x	0.7	x	0.8	=	51.4	(77)
Southeast	0.9x	0.77	x	3.6	x	62.67	x	0.7	x	0.8	=	87.56	(77)
Southeast	0.9x	0.77	x	3.6	x	85.75	x	0.7	x	0.8	=	119.8	(77)
Southeast	0.9x	0.77	x	3.6	x	106.25	x	0.7	x	0.8	=	148.44	(77)
Southeast	0.9x	0.77	x	3.6	x	119.01	x	0.7	x	0.8	=	166.27	(77)

Southeast	0.9x	0.77	x	3.6	x	118.15	x	0.7	x	0.8	=	165.07	(77)
Southeast	0.9x	0.77	x	3.6	x	113.91	x	0.7	x	0.8	=	159.14	(77)
Southeast	0.9x	0.77	x	3.6	x	104.39	x	0.7	x	0.8	=	145.84	(77)
Southeast	0.9x	0.77	x	3.6	x	92.85	x	0.7	x	0.8	=	129.72	(77)
Southeast	0.9x	0.77	x	3.6	x	69.27	x	0.7	x	0.8	=	96.77	(77)
Southeast	0.9x	0.77	x	3.6	x	44.07	x	0.7	x	0.8	=	61.57	(77)
Southeast	0.9x	0.77	x	3.6	x	31.49	x	0.7	x	0.8	=	43.99	(77)
Southwest	0.9x	0.77	x	1.4	x	36.79		0.7	x	0.8	=	19.99	(79)
Southwest	0.9x	0.77	x	1.4	x	62.67		0.7	x	0.8	=	34.05	(79)
Southwest	0.9x	0.77	x	1.4	x	85.75		0.7	x	0.8	=	46.59	(79)
Southwest	0.9x	0.77	x	1.4	x	106.25		0.7	x	0.8	=	57.73	(79)
Southwest	0.9x	0.77	x	1.4	x	119.01		0.7	x	0.8	=	64.66	(79)
Southwest	0.9x	0.77	x	1.4	x	118.15		0.7	x	0.8	=	64.19	(79)
Southwest	0.9x	0.77	x	1.4	x	113.91		0.7	x	0.8	=	61.89	(79)
Southwest	0.9x	0.77	x	1.4	x	104.39		0.7	x	0.8	=	56.72	(79)
Southwest	0.9x	0.77	x	1.4	x	92.85		0.7	x	0.8	=	50.45	(79)
Southwest	0.9x	0.77	x	1.4	x	69.27		0.7	x	0.8	=	37.63	(79)
Southwest	0.9x	0.77	x	1.4	x	44.07		0.7	x	0.8	=	23.94	(79)
Southwest	0.9x	0.77	x	1.4	x	31.49		0.7	x	0.8	=	17.11	(79)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	71.39	121.61	166.39	206.17	230.93	229.26	221.03	202.56	180.17	134.41	85.51	61.1	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	517.92	563.63	590.77	603.94	601.91	576.24	554.43	543.76	537.05	518.07	498.63	496.22	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) | 21 | (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.98	0.98	0.95	0.91	0.8	0.65	0.68	0.85	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.8	20.01	20.3	20.57	20.79	20.89	20.88	20.73	20.39	20	19.68	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.53	19.54	19.54	19.58	19.58	19.61	19.61	19.61	19.6	19.58	19.57	19.56	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.86	0.69	0.47	0.51	0.77	0.93	0.98	0.99	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.83	18.01	18.32	18.75	19.12	19.41	19.49	19.49	19.34	18.89	18.33	17.85	(90)

fLA = Living area ÷ (4) = | 0.23 | (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.25	18.42	18.7	19.1	19.45	19.73	19.81	19.81	19.66	19.23	18.71	18.26	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.25	18.42	18.7	19.1	19.45	19.73	19.81	19.81	19.66	19.23	18.71	18.26	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation factor for gains, hm:														
(94)m=	0.98	0.97	0.96	0.93	0.86	0.7	0.5	0.54	0.77	0.92	0.97	0.98		(94)
Useful gains, hmGm , W = (94)m x (84)m														
(95)m=	508.5	548.9	566.57	559.36	514.76	403.72	278.09	291.05	413.68	478.13	484.07	488.45		(95)
Monthly average external temperature from Table 8														
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2		(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]														
(97)m=	1344.84	1296.01	1163.16	947.88	716.45	462.95	289.7	306.24	506.53	797.9	1083.75	1326.6		(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m														
(98)m=	622.24	502.06	443.86	279.73	150.05	0	0	0	0	237.91	431.77	623.59		
									Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =				3291.21	(98)
Space heating requirement in kWh/m²/year													58.52	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)														
	622.24	502.06	443.86	279.73	150.05	0	0	0	0	237.91	431.77	623.59		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)														(211)
	670.51	541.01	478.3	301.44	161.7	0	0	0	0	256.37	465.27	671.97		
									Total (kWh/year) =Sum(211)$_{1...5,10....12}$=				3546.56	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208)														
(215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
									Total (kWh/year) =Sum(215)$_{1...5,10....12}$=				0	(215)

Water heating

Output from water heater (calculated above)														
	172.49	150.67	156.77	139.04	134.62	118.56	113.59	126.63	128.03	145.79	155.62	168.44		
Efficiency of water heater													83.5	(216)
(217)m=	90.61	90.47	90.18	89.49	88.16	83.5	83.5	83.5	83.5	89.03	90.14	90.65		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m														
(219)m=	190.37	166.54	173.84	155.37	152.7	141.99	136.04	151.65	153.33	163.75	172.65	185.81		
									Total = Sum(219a)$_{1...12}$ =				1944.04	(219)

Annual totals	**kWh/year**	**kWh/year**
Space heating fuel used, main system 1		3546.56

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Water heating fuel used		1944.04	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =	30	(231)
Electricity for lighting		296.02	(232)
Electricity generated by PVs		-619.8	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	123.42	(240)
Space heating - main system 2	(213)	x	0	x 0.01 =	0	(241)
Space heating - secondary	(215)	x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)		3.48	x 0.01 =	67.65	(247)
Pumps, fans and electric keep-hot	(231)		13.19	x 0.01 =	3.96	(249)
(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a						
Energy for lighting	(232)		13.19	x 0.01 =	39.04	(250)
Additional standing charges (Table 12)					120	(251)
	one of (233) to (235) x)		13.19	x 0.01 =	-81.75	(252)
Appendix Q items: repeat lines (253) and (254) as needed						
Total energy cost	(245)...(247) + (250)…(254) =				272.32	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1.13	(257)
SAP rating (Section 12)		84.24	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year		**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211)	x	0.216	=	766.06	(261)
Space heating (secondary)	(215)	x	0.519	=	0	(263)
Water heating	(219)	x	0.216	=	419.91	(264)
Space and water heating	(261) + (262) + (263) + (264) =				1185.97	(265)
Electricity for pumps, fans and electric keep-hot	(231)	x	0.519	=	15.57	(267)
Electricity for lighting	(232)	x	0.519	=	153.63	(268)
Energy saving/generation technologies Item 1			0.519	=	-321.68	(269)
Total CO2, kg/year			sum of (265)…(271) =		1033.5	(272)

CO2 emissions per m²		(272) ÷ (4) =	18.38	(273)
EI rating (section 14)			86	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	4326.8	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	2371.73	(264)
Space and water heating	(261) + (262) + (263) + (264) =			6698.53	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)
Electricity for lighting	(232) x	0	=	908.78	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1902.79	(269)
'Total Primary Energy		sum of (265)…(271) =		5796.61	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		103.07	(273)

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User Details:

Assessor Name:
Stroma Number:
Software Name: Stroma FSAP 2012
Software Version: Version: 1.0.4.6

Property Address: Plot 10

Address :

1. Overall dwelling dimensions:

	Area(m²)		Av. Height(m)		Volume(m³)	
Ground floor	35.53	(1a) x	2.44	(2a) =	86.66	(3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	35.53	(4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	86.66	(5)

2. Ventilation rate:

	main heating		secondary heating		other		total		m³ per hour	
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0	(6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0	(6b)
Number of intermittent fans							2	x 10 =	20	(7a)
Number of passive vents							0	x 10 =	0	(7b)
Number of flueless gas fires							0	x 40 =	0	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.23	(8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)		0	(9)
Additional infiltration	[(9)-1]x0.1 =	0	(10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction		0	(11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0		0	(12)
If no draught lobby, enter 0.05, else enter 0		0	(13)
Percentage of windows and doors draught stripped		0	(14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0	(15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0	(16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10	(17)
If based on air permeability value, then	(18) = [(17) ÷ 20]+(8), otherwise (18) = (16)	0.73	(18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.62	(21)

Infiltration rate modified for monthly wind speed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table 7												
(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
Wind Factor (22a)m = (22)m ÷ 4												
(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.79	0.78	0.76	0.68	0.67	0.59	0.59	0.57	0.62	0.67	0.7	0.73

Calculate effective air change rate for the applicable case

If mechanical ventilation: 0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)) , otherwise (23b) = (23a) 0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) × [1 – (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 × (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 × (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0	(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.81	0.8	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.81	0.8	0.79	0.73	0.72	0.67	0.67	0.67	0.69	0.72	0.74	0.77	(25)

3. Heat losses and heat loss parameter:

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²		U-value W/m2K		A X U (W/K)	k-value kJ/m²·K	A X k kJ/K	
Doors			2	x	1.5	=	3			(26)
Windows			4.7	x1/[1/(1.6)+ 0.04]		=	7.07			(27)
Walls Type1	12.89	4.7	8.19	x	0.3	=	2.46			(29)
Walls Type2	4.46	2	2.46	x	0.27	=	0.66			(29)
Roof	4.33	0	4.33	x	0.3	=	1.3			(30)
Total area of elements, m²			21.68							(31)

** for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2*

*** include the areas on both sides of internal walls and partitions*

Fabric heat loss, W/K = S (A x U) (26)…(30) + (32) = 14.48 (33)

Heat capacity Cm = S(A x k) ((28)…(30) + (32) + (32a)…(32e) = 0 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 3.25 (36)

if details of thermal bridging are not known (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 17.73 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 × (25)m x (5)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.27	22.92	22.58	20.97	20.67	19.28	19.28	19.02	19.82	20.67	21.28	21.92	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

(39)m=	41	40.65	40.31	38.71	38.41	37.01	37.01	36.75	37.55	38.41	39.01	39.65	

Average = $Sum(39)_{1...12}$ /12= 38.71 (39)

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Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

(40)m=	1.15	1.14	1.13	1.09	1.08	1.04	1.04	1.03	1.06	1.08	1.1	1.12

Average = Sum(40)$_{1...12}$ /12= 1.09 (40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement: kWh/year:

Assumed occupancy, N 1.29 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA -13.9)2)] + 0.0013 x (TFA -13.9)

if TFA £ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 64.91 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	71.41	68.81	66.21	63.62	61.02	58.42	58.42	61.02	63.62	66.21	68.81	71.41	

Total = Sum(44)$_{1...12}$ = 778.98 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	105.89	92.62	95.57	83.32	79.95	68.99	63.93	73.36	74.24	86.51	94.44	102.55

Total = Sum(45)$_{1...12}$ = 1021.36 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	15.88	13.89	14.34	12.5	11.99	10.35	9.59	11	11.14	12.98	14.17	15.38	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter ‘0’ in (47)

Water storage loss:

a) If manufacturer’s declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year (48) x (49) = 0 (50)

b) If manufacturer’s declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0 (51)

If community heating see section 4.3

Volume factor from Table 2a 0 (52)

Temperature factor from Table 2b 0 (53)

Energy lost from water storage, kWh/year (47) x (51) x (52) x (53) = 0 (54)

Enter (50) or (54) in (55) 0 (55)

Water storage loss calculated for each month ((56)m = (55) × (41)m

(56)m=	0	0	0	0	0	0	0	0	0	0	0	0	(56)

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) – (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	0	0	0	0	0	0	0	0	0	0	0	0	(57)

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	0	0	0	0	0	0	0	0	0	0	0	0	(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	36.39	31.67	33.74	31.37	31.1	28.81	29.77	31.1	31.37	33.74	33.93	36.39	(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	142.28	124.29	129.31	114.69	111.04	97.8	93.7	104.45	105.61	120.26	128.37	138.94	(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRS and/or WWHRS applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)

Output from water heater

(64)m=	142.28	124.29	129.31	114.69	111.04	97.8	93.7	104.45	105.61	120.26	128.37	138.94	

Output from water heater (annual)$_{1…12}$ 1410.75 (64)

Heat gains from water heating, kWh/month 0.25 ´ [0.85 × (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]

(65)m=	44.31	38.71	40.21	35.55	34.36	30.14	28.7	32.17	32.53	37.2	39.88	43.2	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a):

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	77.6	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

(67)m=	25.99	23.08	18.77	14.21	10.62	8.97	9.69	12.6	16.91	21.47	25.05	26.71	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	164.89	166.6	162.29	153.11	141.52	130.63	123.36	121.65	125.96	135.14	146.73	157.62	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	44.05	44.05	44.05	44.05	44.05	44.05	44.05	44.05	44.05	44.05	44.05	44.05	(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)

Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	-51.73	(71)

Water heating gains (Table 5)

(72)m=	59.55	57.61	54.05	49.37	46.18	41.86	38.57	43.23	45.18	50	55.39	58.06	(72)

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	323.35	320.21	308.03	289.61	271.24	254.38	244.54	250.39	260.96	279.52	300.09	315.3	(73)

6. Solar gains:

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
Northeast	0.9x	0.77	x	4.7	x	11.28	x	0.7	x	0.8	=	20.58	(75)
Northeast	0.9x	0.77	x	4.7	x	22.97	x	0.7	x	0.8	=	41.89	(75)
Northeast	0.9x	0.77	x	4.7	x	41.38	x	0.7	x	0.8	=	75.47	(75)
Northeast	0.9x	0.77	x	4.7	x	67.96	x	0.7	x	0.8	=	123.95	(75)
Northeast	0.9x	0.77	x	4.7	x	91.35	x	0.7	x	0.8	=	166.61	(75)

Northeast 0.9x	0.77	x	4.7	x	97.38	x	0.7	x	0.8	=	177.63	(75)
Northeast 0.9x	0.77	x	4.7	x	91.1	x	0.7	x	0.8	=	166.17	(75)
Northeast 0.9x	0.77	x	4.7	x	72.63	x	0.7	x	0.8	=	132.47	(75)
Northeast 0.9x	0.77	x	4.7	x	50.42	x	0.7	x	0.8	=	91.97	(75)
Northeast 0.9x	0.77	x	4.7	x	28.07	x	0.7	x	0.8	=	51.19	(75)
Northeast 0.9x	0.77	x	4.7	x	14.2	x	0.7	x	0.8	=	25.89	(75)
Northeast 0.9x	0.77	x	4.7	x	9.21	x	0.7	x	0.8	=	16.81	(75)

Solar gains in watts, calculated for each month (83)m = Sum(74)m …(82)m

(83)m=	20.58	41.89	75.47	123.95	166.61	177.63	166.17	132.47	91.97	51.19	25.89	16.81	(83)

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	343.93	362.1	383.5	413.56	437.86	432.01	410.71	382.86	352.93	330.72	325.99	332.11	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (°C) 21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.98	0.96	0.89	0.74	0.54	0.39	0.44	0.69	0.91	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.26	20.35	20.51	20.75	20.89	20.94	20.95	20.95	20.92	20.75	20.5	20.27	(87)

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.96	19.96	19.97	20.01	20.02	20.05	20.05	20.05	20.04	20.02	20	19.99	(88)

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.97	0.94	0.86	0.69	0.46	0.31	0.35	0.61	0.88	0.96	0.98	(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.99	19.13	19.37	19.71	19.89	19.97	19.98	19.98	19.94	19.73	19.37	19.03	(90)

fLA = Living area ÷ (4) = 0.7 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.87	19.98	20.16	20.43	20.58	20.65	20.65	20.65	20.62	20.44	20.15	19.9	(92)

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.87	19.98	20.16	20.43	20.58	20.65	20.65	20.65	20.62	20.44	20.15	19.9	(93)

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, hm:													
(94)m=	0.98	0.97	0.95	0.87	0.72	0.51	0.36	0.41	0.66	0.89	0.96	0.98	(94)
Useful gains, hmGm , W = (94)m x (84)m													
(95)m=	336.61	351.25	362.69	359.89	315.67	220.75	149.61	155.67	233.27	294.75	313.78	325.87	(95)
Monthly average external temperature from Table 8													
(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
Heat loss rate for mean internal temperature, Lm , W =[(39)m x [(93)m– (96)m]													
(97)m=	638.57	612.95	550.85	446.33	341.14	223.79	150.01	156.36	244.88	377.93	509.27	622.32	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m – (95)m] x (41)m													
(98)m=	224.66	175.87	139.99	62.24	18.95	0	0	0	0	61.88	140.76	220.56	

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Total per year (kWh/year) = Sum(98)$_{1...5,9...12}$ =	1044.9	(98)
Space heating requirement in kWh/m²/year	29.41	(99)

9a. Energy requirements – Individual heating systems including micro-CHP)

Space heating:

Fraction of space heat from secondary/supplementary system		0	(201)
Fraction of space heat from main system(s)	(202) = 1 – (201) =	1	(202)
Fraction of total heating from main system 1	(204) = (202) × [1 – (203)] =	1	(204)
Efficiency of main space heating system 1		92.8	(206)
Efficiency of secondary/supplementary heating system, %		0	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Space heating requirement (calculated above)	224.66	175.87	139.99	62.24	18.95	0	0	0	0	61.88	140.76	220.56		
(211)m = {[(98)m x (204)] } x 100 ÷ (206)	242.09	189.51	150.85	67.07	20.42	0	0	0	0	66.69	151.68	237.67		(211)
Total (kWh/year) =Sum(211)$_{1...5,10...12}$=													1125.97	(211)
Space heating fuel (secondary), kWh/month = {[(98)m x (201)] } x 100 ÷ (208) (215)m=	0	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215)$_{1...5,10...12}$=													0	(215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year	
Output from water heater (calculated above)	142.28	124.29	129.31	114.69	111.04	97.8	93.7	104.45	105.61	120.26	128.37	138.94		
Efficiency of water heater													83.5	(216)
(217)m=	88.96	88.71	88.09	86.55	84.74	83.5	83.5	83.5	83.5	86.44	88.12	88.97		(217)
Fuel for water heating, kWh/month (219)m = (64)m x 100 ÷ (217)m (219)m=	159.94	140.11	146.8	132.52	131.04	117.13	112.22	125.09	126.48	139.11	145.68	156.16		
Total = Sum(219a)$_{1...12}$ =													1632.28	(219)

Annual totals		**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1			1125.97	
Water heating fuel used			1632.28	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
Total electricity for the above, kWh/year	sum of (230a)…(230g) =		30	(231)
Electricity for lighting			183.57	(232)
Electricity generated by PVs			-391.65	(233)

10a. Fuel costs - individual heating systems:

	Fuel kWh/year		**Fuel Price** (Table 12)		**Fuel Cost** £/year	
Space heating - main system 1	(211)	x	3.48	x 0.01 =	39.18	(240)

Space heating - main system 2	(213) x	0	x 0.01 =	0	(241)
Space heating - secondary	(215) x	13.19	x 0.01 =	0	(242)
Water heating cost (other fuel)	(219)	3.48	x 0.01 =	56.8	(247)
Pumps, fans and electric keep-hot	(231)	13.19	x 0.01 =	3.96	(249)

(if off-peak tariff, list each of (230a) to (230g) separately as applicable and apply fuel price according to Table 12a

Energy for lighting	(232)	13.19	x 0.01 =	24.21	(250)
Additional standing charges (Table 12)				120	(251)
	one of (233) to (235) x)	13.19	x 0.01 =	-51.66	(252)

Appendix Q items: repeat lines (253) and (254) as needed

Total energy cost	(245)...(247) + (250)…(254) =	192.5	(255)

11a. SAP rating - individual heating systems

Energy cost deflator (Table 12)		0.42	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	1	(257)
SAP rating (Section 12)		85.99	(258)

12a. CO2 emissions – Individual heating systems including micro-CHP

	Energy kWh/year	**Emission factor** kg CO2/kWh		**Emissions** kg CO2/year	
Space heating (main system 1)	(211) x	0.216	=	243.21	(261)
Space heating (secondary)	(215) x	0.519	=	0	(263)
Water heating	(219) x	0.216	=	352.57	(264)
Space and water heating	(261) + (262) + (263) + (264) =			595.78	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	=	15.57	(267)
Electricity for lighting	(232) x	0.519	=	95.27	(268)
Energy saving/generation technologies					
Item 1		0.519	=	-203.27	(269)
Total CO2, kg/year		sum of (265)…(271) =		503.36	(272)
CO2 emissions per m²		(272) ÷ (4) =		14.17	(273)
EI rating (section 14)				92	(274)

13a. Primary Energy

	Energy kWh/year	**Primary** factor		**P. Energy** kWh/year	
Space heating (main system 1)	(211) x	1.22	=	1373.69	(261)
Space heating (secondary)	(215) x	3.07	=	0	(263)
Energy for water heating	(219) x	1.22	=	1991.38	(264)
Space and water heating	(261) + (262) + (263) + (264) =			3365.07	(265)
Electricity for pumps, fans and electric keep-hot	(231) x	3.07	=	92.1	(267)

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Electricity for lighting	(232) x	0	=	563.56	(268)
Energy saving/generation technologies					
Item 1		3.07	=	-1202.38	(269)
'Total Primary Energy		sum of (265)…(271) =		2818.35	(272)
Primary energy kWh/m²/year		(272) ÷ (4) =		79.32	(273)

APPENDIX C – SBEM RESULTS

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Finchley Road_Lean

As built

Date: Tue Aug 22 18:20:31 2017

Administrative information

Building Details

Address: Address 1, Address 2, City, Postcode

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.g.3

Interface to calculation engine: Virtual Environment

Interface to calculation engine version: v7.0.6

BRUKL compliance check version: v5.2.g.3

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 should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	23.4
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	23.4
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	18
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 the building services should achieve reasonable overall standards of energy efficiency

Values not achieving 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	0.31	0.31	RM000001_W1
Floor	0.25	0.25	0.25	RM000001_F
Roof	0.25	-	-	"No heat loss roofs"
Windows***, roof windows, and rooflights	2.2	1.6	1.6	RM000001_W12_O0
Personnel doors	2.2	3.08	3.08	RM000006_W4_O0
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a-Limit}$ = 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
$m^3/(h.m^2)$ at 50 Pa	10	10

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Main system

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	6	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.

1- SYST0000-DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	-
Standard value	N/A	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
B1 basement	-	-	-	0.8	-	-	-	-	-	0.7	0.5
A2	-	-	-	0.8	-	-	-	-	-	0.7	0.5
B1 Ground	-	-	-	0.8	-	-	-	-	-	0.7	0.5

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	**Luminaire**	**Lamp**	**Display lamp**	**General lighting [W]**
Standard value	60	60	22	
B1 basement	68	-	-	1105
A2	-	80	80	699
B1 Ground	68	-	-	675

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
B1 basement	NO (-94%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
A2	NO (-41.7%)	NO
B1 Ground	NO (-60.7%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	244.3	244.3
External area [m^2]	363	363
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	10	5
Average conductance [W/K]	166.49	212.19
Average U-value [W/m^2K]	0.46	0.58
Alpha value* [%]	19.4	19.23

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
20	**A1/A2 Retail/Financial and Professional services**
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
80	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	4.87	6.17
Cooling	6.07	11.24
Auxiliary	3.27	2.92
Lighting	20.57	24.79
Hot water	0.7	1.03
Equipment*	37.7	37.7
TOTAL**	**35.47**	**46.15**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	158.35	199.73
Primary energy* [kWh/m^2]	106.18	138.15
Total emissions [kg/m^2]	18	23.4

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	65.3	93.1	4.9	6.1	3.3	3.73	4.26	4	6
	Notional	54	145.7	6.2	11.2	2.9	2.43	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.31	RM000001_W1
Floor	0.2	0.25	RM000001_F
Roof	0.15	-	"No heat loss roofs"
Windows, roof windows, and rooflights	1.5	1.6	RM000001_W12_O0
Personnel doors	1.5	3.08	RM000006_W4_O0
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)]

$U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

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

Air Permeability	Typical value	This building
$m^3/(h.m^2)$ at 50 Pa	5	10

APPENDIX D – SURFACE WATER CALCULATIONS

MasterDrain
HY 9.36

XCO2 Energy Ltd
www.xco2.com

17-18 Haywards Place,
Clerkenwell,
London EC1R 0EQ
Tel: +44 (0)20 7700 1000
Email: mail@xco2energy.com

Job No.	Sheet no.	Date	By	Checked	Reviewed
8.996	1	22/08/17	JC		

Project 307-309 Finchley Road

Title Surface Water Runoff

Data:-

Hydrology:-

Location = Finchley Road	WRAP = 2
Long reference = 0	Grid reference =
M5-60 (mm) = 21	SAAR (mm/yr) = 600
r = 0.45	Soil =0.30
Hyd. area = 7	Hyd. zone = 8
Hydrograph = Summer	Area = England and Wales

Site values used in design:-

Total site area = 0.0528 ha	Climate change factor = 40%
Pre-dev area drained = 0.0528 ha	Post-dev area drained = 0.0528 ha
Imperm runoff factor = 98%	Perm runoff factor = 20%

Pre-development

Area to soakaways = 0.0000 ha	Area to other SUDS = 0.0000 ha
Perv. area to SUDS = 0.0000 ha	Pre-dev flow to drain = 0.00 l/s

Post-development

Area to soakaways = 0.0000 ha	Area to other SUDS = 0.0000 ha
Perv. area to SUDS = 0.0000 ha	Post-dev flow to drain = 0.00 l/s

Calculations:-

Revised Post-dev Imperm. area = 0.053 ha
Equiv. Post-dev Imperm. area = 0.052 ha
Equiv. Post-dev Perm. area = 0.000 ha
Total Pre-dev equiv. area ha = 0.052 ha
Total Post-dev equiv. area ha = 0.052 ha
100 yr 6 hour mean intensity = 10.37mm/hr

Results:-

Pre-dev peakflow runoff (l/s)(m^3/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	19.2	12.5	7.8	4.6	2.8	2.1	1.7	1.4	19.2	N/A	19.2	1
30	46.9	29.9	18.2	10.8	6.2	4.5	3.6	3.0	46.9	N/A	46.9	30
100	61.1	39.3	24.0	14.2	8.1	5.8	4.6	3.9	61.1	N/A	61.1	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	19.2	12.5	7.8	4.6	2.8	2.1	1.7	1.4	19.2	40	26.9	1
30	46.9	29.9	18.2	10.8	6.2	4.5	3.6	3.0	46.9	40	65.7	30
100	61.1	39.3	24.0	14.2	8.1	5.8	4.6	3.9	61.1	40	85.6	100

100 year 6 hour (x Climate Change Factor) storm gives:-

Pre-dev runoff volume m^3 = 32.2m^3
Post-dev rainfall volume = 45.1m^3
Post-dev volume m^3 (excess above SUDS) = 45.1m^3
100 yr 6 hour mean intensity = 10.37mm/hr
Pre-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev storage volume = 45.1m^3
Post-dev 5mm imperm volume = 2.6 m^3
Post-dev 5mm perm volume = 0.0 m^3

$Q_{BAR(rural)}$ = 0.080 l/s or 1.522 l/s/ha or 0.000 cumecs - from IoH 124.

The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area =	0.0528 ha ;528.0 m² [3A]
Pre-development impermeable area =	0.0528 ha [3B]
Pre-development permeable area =	0.0000 ha
Post-development impermeable area =	0.0528 ha [3C]
Post-development permeable area =	0.0000 ha

Peak runoff:-

Pre-development 1 year storm (15min) =	19.2 l/s [6A]
Pre-development 100 year storm (15min) =	61.1 l/s [6C]
Post-development 1 year storm (15min) =	19.2 l/s [6B]
Post-development 100 year storm (15min)=	61.11 l/s [6D]

Greenfield runoff:-

$Q_{BAR(rural)}$ = 0.080 l/s or 1.522 l/s/ha or 0.000 cumecs - from IoH 124.

Climate change factor:-

CCF = 40%

Volumes:-

Pre-development 100 yr/6hr storm [12A]= 45.1m³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]= 45.1m³
Post-development 100 yr/6hr storm (add. volume with SUDS) = 45.1m³
Post-development add. predicted volume (No SUDS) [12C] = 0.0m³

You may also require

Data relating to the infiltration test calculations (if applicable)
Evidence to show runoff reduction (if applicable)
Information on calculation methods (if applicable see next sheet)

Note

Numbers in square brackets relate to the
Nov. 2010 v1.1 / issued 11/02/10 copy of SUR1

Definitions and methods

Hydrology

The hydrological constants are derived from the Wallingford maps. They are used to calculate location specific rainfall figures.

Site values and factors

Areas of the site should be entered in hectares (10000 m²). If the Pre-development site is a green field, this box is blank.
Climate Change Factor is initially set at 20% - this may be changed as required.
Greenfield runoff is calculated using the method described in IoH 124.
Runoff factors
    The impermeable runoff factor is initially set at 98%
    The permeable runoff factor is initially set at 20%

Note: the CCF and the runoff factors may be changed by the user to suit the development
The areas draining to soakaways and other SUDS are entered in the appropriate box (in hectares)

Calculations

The post-development area is reduced by subtracting the areas that drain to soakaways or other SUDS, to give a revised figure.
All areas are then multiplied by the appropriate runoff factor to give an equivalent area with 100% runoff.
These are then summated.
This gives a total pre-development equivalent area, and a similar figure for the post-development area.
The 'Post-dev volume to drain (no SUDS)' gives the total runoff to drain if no SUDS were used.

Results

The pre- and post-development areas are subjected to 1,30 and 100 year return period storms with a duration of 15 to 600 minutes.
The Revised Post-dev Imperm. area is the area (in ha) that is not going to SUDS x impervious runoff factor.
The runoff rates are calculated for the chosen hydrograph (Summer or Winter) as l/s. Figures in red indicate m³/s
The peak value is measured, multiplied by the CCF and the total maximum rate is shown.
The pre- and post-development volumes for a 100 year / 6 hour storm are calculated from the area under the hydrograph curve.
Post-dev volume (i.e. excess above SUDS) is that volume produced by the drained area that does not go to SUDS.
Qbar(rural) is calculated in accordance with the procedure laid down in IoH 124

Company				Project	
XCO2 Energy Ltd				Finchley Road	
Item				Job Ref	Sheet no.
Storage volume				8.996	1
Calc. by	Date	Checked by	Date	Approved by	Date
JC	22/08/17				

MasterDrain

Data:-

Hydrology:-

Grid reference =
M5-60 (mm) = 21
WRAP/Soil = 2 / 0.30
Return period = 100
Climate change factor = 40%
Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Location = Finchley Road
r = 0.45
SAAR (mm/yr) = 600
Mean intensity = 14.5mm/hr for a 6.00 hour storm
Storm duration = 6.00 hrs
Available MH storage = 0.0 m³

Percentage runoff = 98.0% (manual setting)

Imperv. area = 528 m²
Total area = 528 m²
Total runoff = 45.1 m³

Pervious area = 0 m²
Equiv area = 517 m² (Tot. area x % runoff).
Discharge rate = 5.000 l/s

Storage (m³) = 4.2 m³ (Sum of all balance quantities)
Total rainfall depth = 87.1 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.060	32.0	4.6	0.144	1.080	0.000	0.000
0.120	33.0	4.8	0.149	1.080	0.000	0.000
0.180	33.0	4.8	0.149	1.080	0.000	0.000
0.240	34.0	4.9	0.153	1.080	0.000	0.000
0.300	34.0	4.9	0.153	1.080	0.000	0.000
0.360	35.0	5.1	0.158	1.080	0.000	0.000
0.420	35.0	5.1	0.158	1.080	0.000	0.000
0.480	36.0	5.2	0.162	1.080	0.000	0.000
0.540	36.0	5.2	0.162	1.080	0.000	0.000
0.600	37.0	5.4	0.167	1.080	0.000	0.000
0.660	37.0	5.4	0.167	1.080	0.000	0.000
0.720	38.0	5.5	0.171	1.080	0.000	0.000
0.780	38.0	5.5	0.171	1.080	0.000	0.000
0.840	39.0	5.7	0.176	1.080	0.000	0.000
0.900	40.0	5.8	0.180	1.080	0.000	0.000
0.960	42.0	6.1	0.189	1.080	0.000	0.000
1.020	42.0	6.1	0.189	1.080	0.000	0.000
1.080	43.0	6.2	0.194	1.080	0.000	0.000
1.140	44.0	6.4	0.198	1.080	0.000	0.000
1.200	45.0	6.5	0.203	1.080	0.000	0.000
1.260	46.0	6.7	0.207	1.080	0.000	0.000
1.320	48.0	7.0	0.216	1.080	0.000	0.000
1.380	49.0	7.1	0.221	1.080	0.000	0.000
1.440	51.0	7.4	0.230	1.080	0.000	0.000
1.500	52.0	7.6	0.234	1.080	0.000	0.000
1.560	54.0	7.8	0.243	1.080	0.000	0.000
1.620	56.0	8.1	0.252	1.080	0.000	0.000
1.680	58.0	8.4	0.262	1.080	0.000	0.000
1.740	61.0	8.9	0.275	1.080	0.000	0.000
1.800	64.0	9.3	0.289	1.080	0.000	0.000
1.860	68.0	9.9	0.307	1.080	0.000	0.000
1.920	72.0	10.5	0.325	1.080	0.000	0.000
1.980	78.0	11.3	0.352	1.080	0.000	0.000
2.040	84.0	12.2	0.379	1.080	0.000	0.000
2.100	91.0	13.2	0.410	1.080	0.000	0.000
2.160	99.0	14.4	0.446	1.080	0.000	0.000
2.220	110.0	16.0	0.496	1.080	0.000	0.000
2.280	123.0	17.9	0.555	1.080	0.000	0.000
2.340	136.0	19.8	0.613	1.080	0.000	0.000
2.400	152.0	22.1	0.685	1.080	0.000	0.000

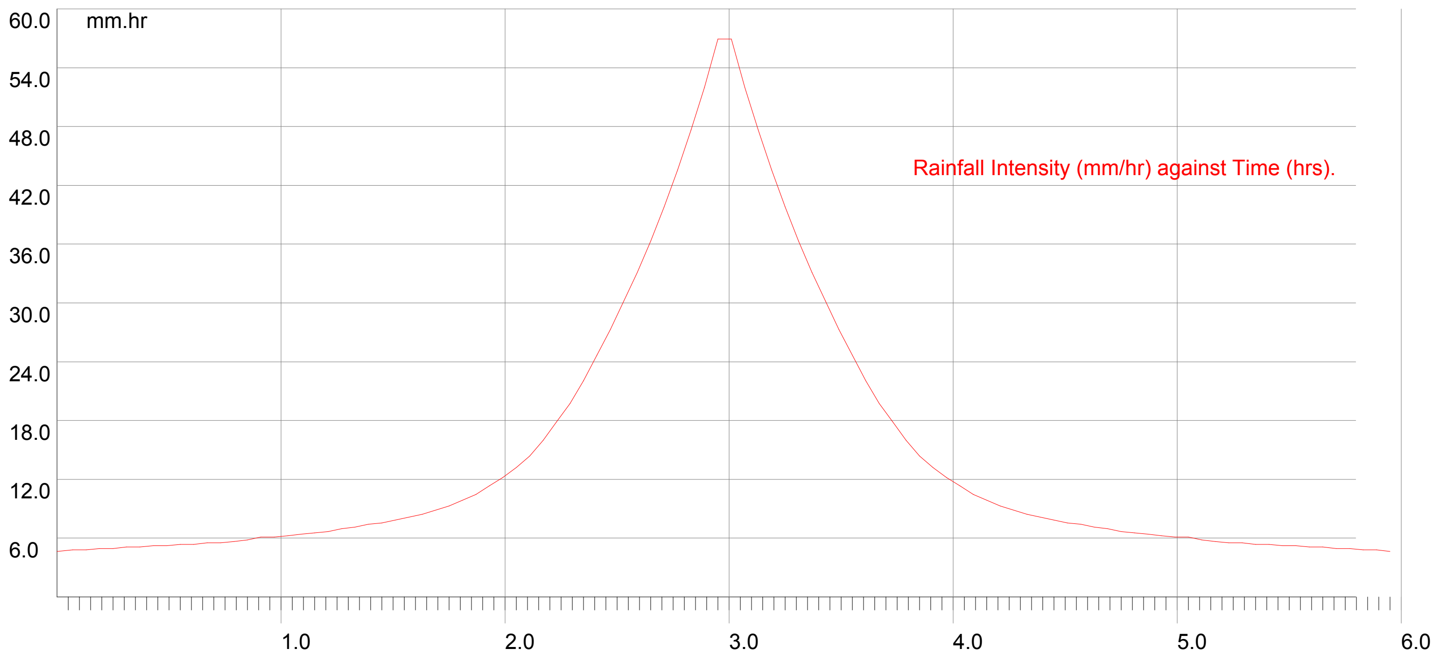
MasterDrain	Company: XCO2 Energy Ltd				Project: Finchley Road	
	Item: Storage volume				Job Ref: 8.996	Sheet no.: 2
	Calc. by: JC	Date: 22/08/17	Checked by:	Date:	Approved by:	Date:

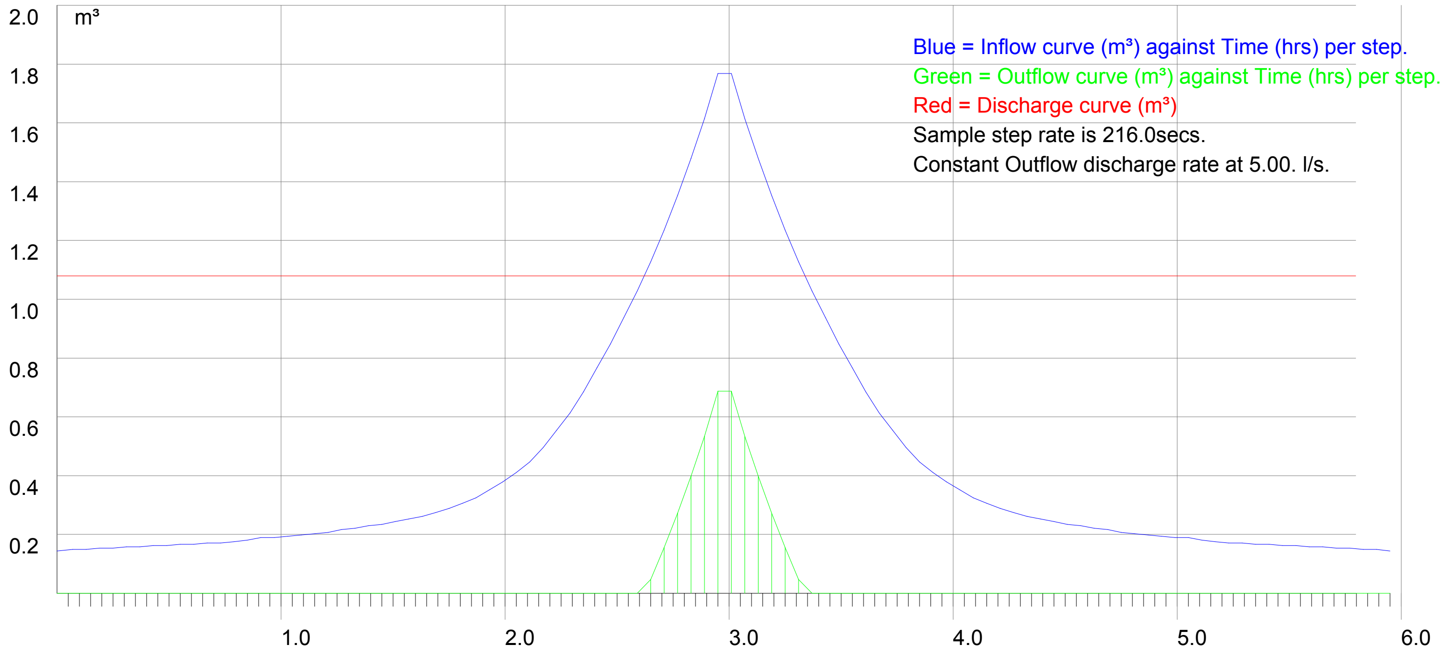
Calculations (cont.) :-

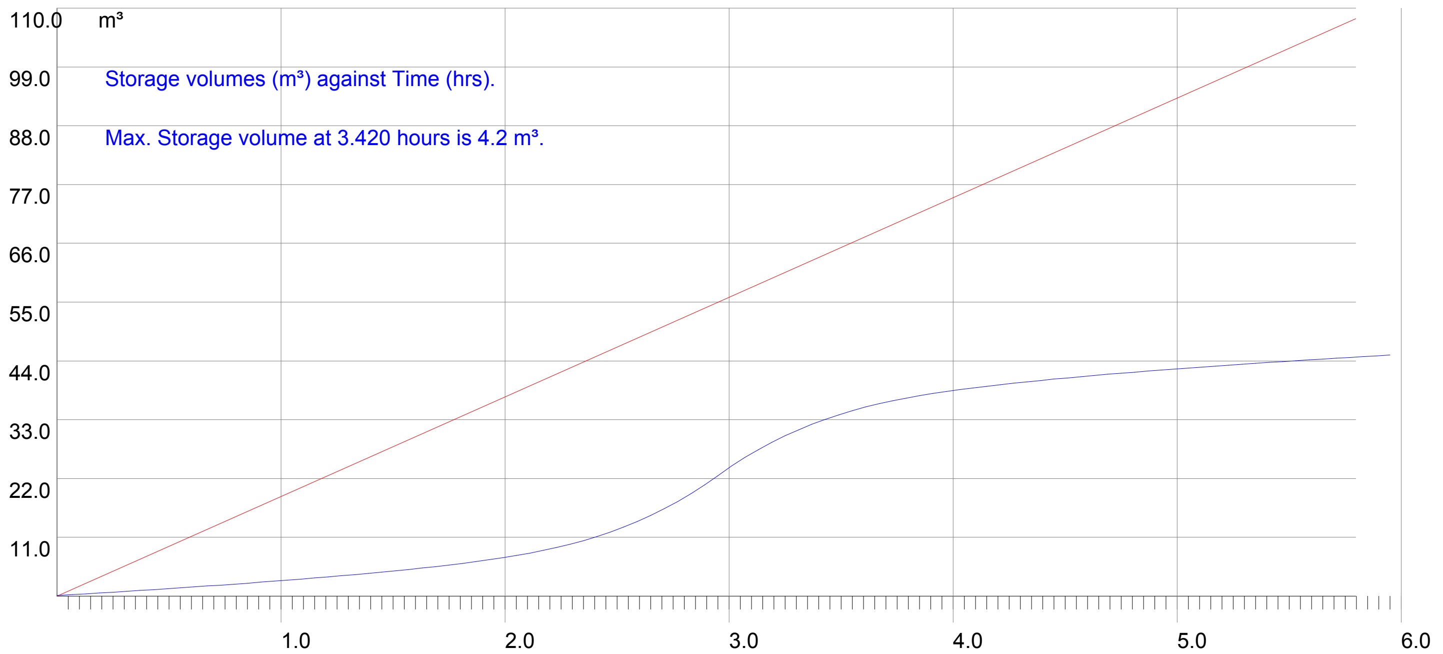
Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
2.460	170.0	24.7	0.766	1.080	0.000	0.000
2.520	188.0	27.3	0.848	1.080	0.000	0.000
2.580	208.0	30.2	0.938	1.080	0.000	0.000
2.640	228.0	33.1	1.028	1.080	0.000	0.000
2.700	250.0	36.3	1.127	1.080	0.047	0.047
2.760	274.0	39.8	1.235	1.080	0.155	0.203
2.820	300.0	43.6	1.353	1.080	0.273	0.475
2.880	328.0	47.6	1.479	1.080	0.399	0.874
2.940	358.0	52.0	1.614	1.080	0.534	1.408
3.000	392.0	56.9	1.767	1.080	0.687	2.096
3.060	392.0	56.9	1.767	1.080	0.687	2.783
3.120	358.0	52.0	1.614	1.080	0.534	3.317
3.180	328.0	47.6	1.479	1.080	0.399	3.716
3.240	300.0	43.6	1.353	1.080	0.273	3.989
3.300	274.0	39.8	1.235	1.080	0.155	4.144
3.360	250.0	36.3	1.127	1.080	0.047	4.191
3.420	228.0	33.1	1.028	1.080	0.000	4.139
3.480	208.0	30.2	0.938	1.080	0.000	3.997
3.540	188.0	27.3	0.848	1.080	0.000	3.765
3.600	170.0	24.7	0.766	1.080	0.000	3.451
3.660	152.0	22.1	0.685	1.080	0.000	3.057
3.720	136.0	19.8	0.613	1.080	0.000	2.590
3.780	123.0	17.9	0.555	1.080	0.000	2.064
3.840	110.0	16.0	0.496	1.080	0.000	1.480
3.900	99.0	14.4	0.446	1.080	0.000	0.847
3.960	91.0	13.2	0.410	1.080	0.000	0.177
4.020	84.0	12.2	0.379	1.080	0.000	0.000
4.080	78.0	11.3	0.352	1.080	0.000	0.000
4.140	72.0	10.5	0.325	1.080	0.000	0.000
4.200	68.0	9.9	0.307	1.080	0.000	0.000
4.260	64.0	9.3	0.289	1.080	0.000	0.000
4.320	61.0	8.9	0.275	1.080	0.000	0.000
4.380	58.0	8.4	0.262	1.080	0.000	0.000
4.440	56.0	8.1	0.252	1.080	0.000	0.000
4.500	54.0	7.8	0.243	1.080	0.000	0.000
4.560	52.0	7.6	0.234	1.080	0.000	0.000
4.620	51.0	7.4	0.230	1.080	0.000	0.000
4.680	49.0	7.1	0.221	1.080	0.000	0.000
4.740	48.0	7.0	0.216	1.080	0.000	0.000
4.800	46.0	6.7	0.207	1.080	0.000	0.000
4.860	45.0	6.5	0.203	1.080	0.000	0.000
4.920	44.0	6.4	0.198	1.080	0.000	0.000
4.980	43.0	6.2	0.194	1.080	0.000	0.000
5.040	42.0	6.1	0.189	1.080	0.000	0.000
5.100	42.0	6.1	0.189	1.080	0.000	0.000
5.160	40.0	5.8	0.180	1.080	0.000	0.000
5.220	39.0	5.7	0.176	1.080	0.000	0.000
5.280	38.0	5.5	0.171	1.080	0.000	0.000
5.340	38.0	5.5	0.171	1.080	0.000	0.000
5.400	37.0	5.4	0.167	1.080	0.000	0.000
5.460	37.0	5.4	0.167	1.080	0.000	0.000
5.520	36.0	5.2	0.162	1.080	0.000	0.000
5.580	36.0	5.2	0.162	1.080	0.000	0.000
5.640	35.0	5.1	0.158	1.080	0.000	0.000
5.700	35.0	5.1	0.158	1.080	0.000	0.000
5.760	34.0	4.9	0.153	1.080	0.000	0.000
5.820	34.0	4.9	0.153	1.080	0.000	0.000
5.880	33.0	4.8	0.149	1.080	0.000	0.000
5.940	33.0	4.8	0.149	1.080	0.000	0.000
6.000	32.0	4.6	0.144	1.080	0.000	0.000

Storage volume (m^3) = 4.2 m^3 (Sum of all balance quantities)

MasterDrain	Company XCO2 Energy Ltd				Project Finchley Road	
	Item Storage volume				Job Ref 8.996	Sheet no. 3
	Calc. by JC	Date 22/08/17	Checked by	Date	Approved by	Date







Company	Project	
XCO2 Energy Ltd	Finchley Road	
Item	Job Ref	Sheet no.
Storage volume	8.996	4

MasterDrain

Calc. by	Date	Checked by	Date	Approved by	Date
JC	22/08/17				

Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m^3)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	0.00	0.25	151.84	0.2	
0.5	0.00	0.50	97.58	0.3	
1	0.00	---	59.61	0.6	
2	0.00	---	35.17	1.2	
3	0.00	---	25.51	1.8	
4	0.00	---	20.20	2.4	
5	0.00	---	16.84	3.0	
6	0.00	---	14.52	3.6	
7	0.00	---	12.81	4.2	
8	0.00	---	11.49	4.8	
9	0.00	---	10.43	5.4	
10	0.00	---	9.57	6.0	
12	0.00	---	8.24	7.2	
15	0.00	---	6.86	9.0	
18	0.00	---	5.90	10.8	
20	0.00	---	5.41	12.0	
24	0.00	---	4.65	14.4	
30	0.00	---	3.87	18.0	
36	0.00	---	3.33	21.6	
42	0.00	---	2.93	25.2	
48	0.00	---	2.62	28.8	
54	0.00	---	2.37	32.4	
60	0.00	---	2.17	36.0	
66	0.00	---	2.01	39.6	
72	0.00	---	1.87	43.2	
84	0.00	---	1.64	50.4	
96	0.00	---	1.47	57.6	
120	0.00	---	1.22	72.0	
150	0.00	---	1.01	90.0	
175	0.00	---	0.89	105.0	
200	0.00	---	0.79	120.0	
250	0.00	---	0.66	150.0	
300	0.00	---	0.56	180.0	
375	0.00	---	0.47	225.0	
500	0.00	---	0.37	300.0	
750	0.00	---	0.26	450.0	
1000	0.00	---	0.20	600.0	
1250	0.00	---	0.17	750.0	
1500	0.00	---	0.15	900.0	
1570	0.00	---	0.14	942.0	
2000	0.00	---	0.11	1200.0	
2500	0.00	---	0.09	1500.0	
3000	0.00	---	0.08	1800.0	
3500	0.00	---	0.07	2100.0	
4000	0.00	---	0.06	2400.0	

Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function.
Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

APPENDIX E – THAMES WATER ASSET PLAN

Asset location search

Thames Water Property Searches

XCO2 Energy Ltd
56Kingsway Place
SANS WALK
LONDON
EC1R 0LU

Search address supplied	307-309 Finchley Road 309 Finchley Road London NW3 6EH
Your reference	Finchley Road
Our reference	ALS/ALS Standard/2017_3632604
Search date	15 August 2017

Keeping you up-to-date

Knowledge of features below the surface is essential in every development. The benefits of this not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility for any commercial or residential project.

An asset location search provides information on the location of known Thames Water clean and/or wastewater assets, including details of pipe sizes, direction of flow and depth. Please note that information on cover and invert levels will only be provided where the data is available.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0845 070 9148

searchcode

Asset location search

Search address supplied: 307-309 Finchley Road, 309, Finchley Road, London, NW3 6EH

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Asset location search

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

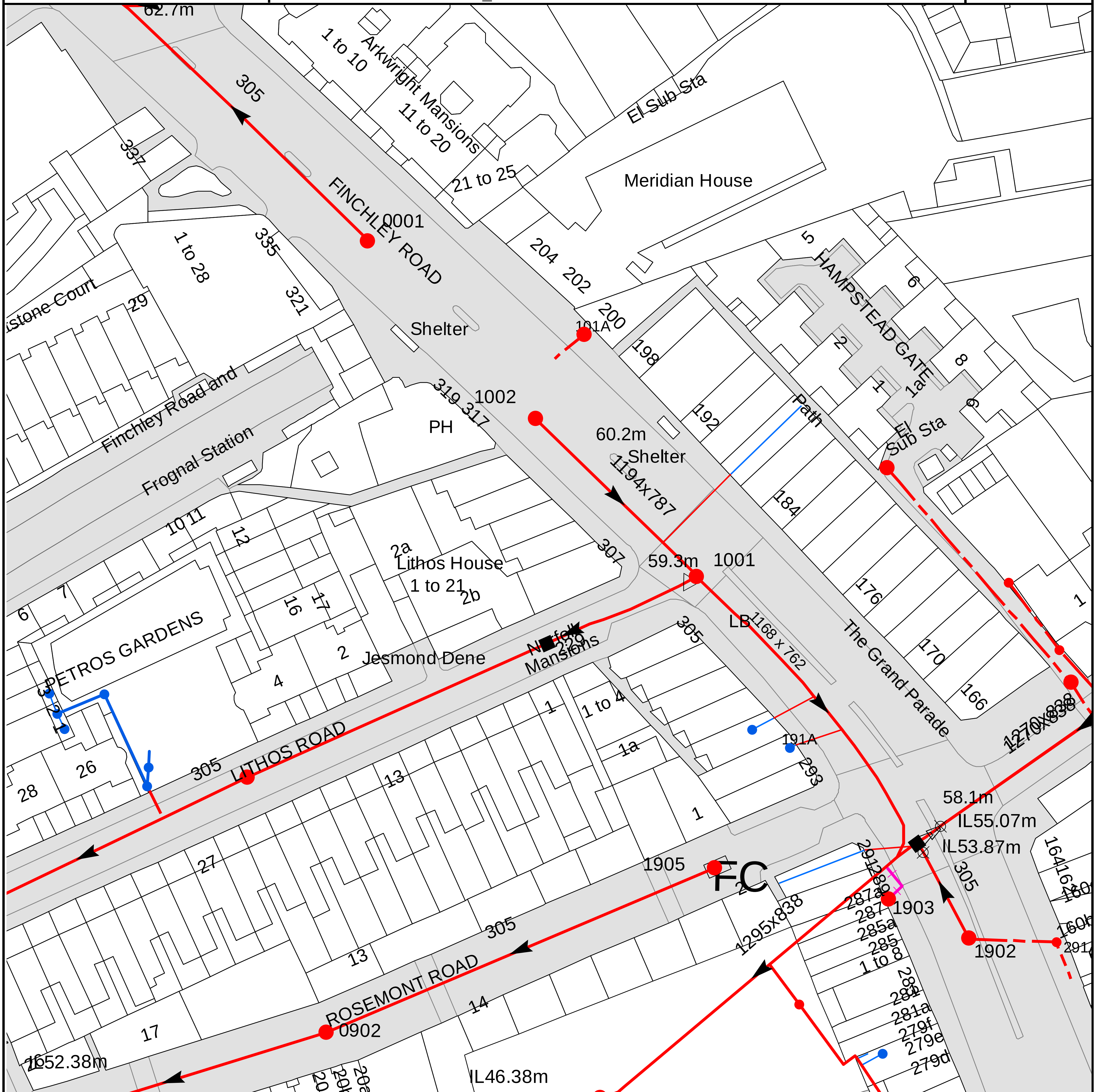
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0845 850 2777
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2017_3632604



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 526105,185013

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
191C	n/a	n/a
191D	n/a	n/a
291A	n/a	n/a
1902	57.86	54.02
0902	57.55	53.8
091C	n/a	n/a
091B	n/a	n/a
091H	n/a	n/a
091F	n/a	n/a
091E	n/a	n/a
091D	n/a	n/a
091G	n/a	n/a
0001	61.45	58.7
1903	n/a	n/a
1905	58.3	55.92
191A	n/a	n/a
191B	n/a	n/a
2901	n/a	n/a
1916	n/a	n/a
1005	n/a	n/a
1001	59.4	54.85
1004	n/a	n/a
1002	60.41	55.76
101A	n/a	n/a

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ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

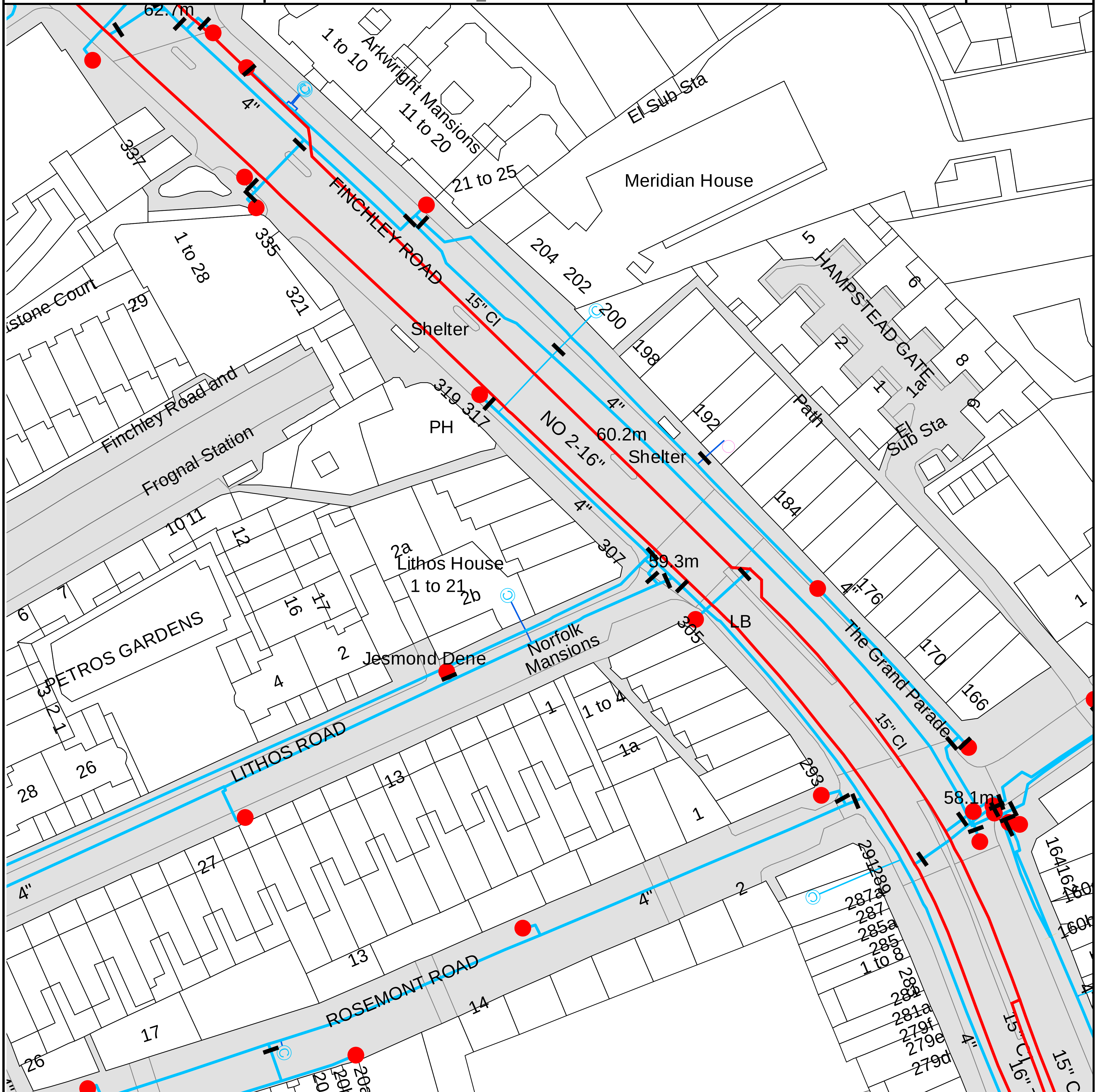
Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2017_3632604



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 526105, 185013.

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ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"
Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"
Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY
Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE
Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED
Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	Cheque
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports
- act with integrity and carry out work with due skill, care and diligence
- at all times maintain adequate and appropriate insurance to protect consumers
- conduct business in an honest, fair and professional manner
- handle complaints speedily and fairly
- ensure that products and services comply with industry registration rules and standards and relevant laws
- monitor their compliance with the Code

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs Contact Details

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE

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