SRE

Harepath LLP

The Dairy
Market Road
Richmond
TW9 4LZ

Sustainability and Energy Statement
(Incl. Code for Sustainable Homes and BREEAM)

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Glossary:

ASHP	Air Source Heat Pump
CHP	Combined Heat & Power
EAHR	Exhaust Air Heat Recovery
CO_2	Carbon Dioxide – usually measured in $kgCO_2/yr$
CS	Core Strategy
CSH	Code for Sustainable Homes
DC	District Council
DPD	Development Plan Document
FGHR	Flue Gas Heat Recovery
GSHP	Ground Source Heat Pump
HP	Heat Pump
kg	Kilograms
kWh	kilo-Watt-hour – kW is peak load, kWh/yr is annual figure
LBRUT	London Borough of Richmond upon Thames
No.	Number of items
Offset	Use of this fuel/technology offsets an amount of energy/$_{CO2}$ generated off-site – e.g. the use of PV does not *reduce* electrical use, but *offsets* it through on-site generation
PV	Photovoltaic
PV-T	Photovoltaic-Thermal (Brand Name)
SWH	Solar Water Heating
TFA	Total Floor Area (Internal)
The Agent	The party who requested the scope of works
The Client	The party who is developing the property (generally the invoicee)
The Proposed Development	The new build/refurbishment on which the planning application is based

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Executive Summary

0.1 This Sustainability and Energy Statement has been undertaken by SRE for the Proposed Development at The Dairy, Market Road, Richmond (Proposed Development) in order to meet the requirements of the London Borough of Richmond upon Thames Sustainable Construction Checklist and wider London Plan Policies.

0.2 The Proposed Development will meet all of the relevant Sustainable Construction Checklist policies in the provision of a resource efficient, sustainable residential development.

0.3 This statement assesses 'Best Practice', energy efficiency measures and renewable energy solutions for the Proposed Development, taking into consideration both the technical and the economic viability of the proposals in order to meet the 20% CO_2 emissions reduction target from on-site renewable energy technologies, and the wider 25% improvement over Building Regulations 2010 compliance as required by The London Plan and Richmond Development Management Plan.

0.4 The inclusion of energy efficiency measures has been discussed to minimise on-site energy use compared to a building regulation compliant design, including high efficiency gas heating systems, improved insulation levels, high specification glazing and energy efficient lighting and appliances.

0.5 Overall, **the Proposed Development will aim to achieve 25% improvement in its Dwelling Emission rate over a Building Regulation 2010 compliant design**.

0.6 The assessment of viable on-site renewable energy generation in relation to the design, site location and orientation concludes that **the installation of a Photovoltaic Array and Air Source Heat Pumps will offset 20.8% of the predicted CO_2 emissions of site**, based on the predicted energy baseline.

0.7 In addition, this report assesses the Proposed Development in relation to wider Sustainability requirements for the area, relating to both local and regional planning policy.

0.8 The Proposed Development goes as far as is practical in meeting all of the relevant requirements set out within the London Borough of Richmond, Sustainable Construction Checklist, and consequently meets all planning requirements (for sustainability) related to the site.

1.0 Introduction

1.1 The Sustainability and Energy Statement has been prepared by SRE to accompany the planning application for the Proposed Development at The Dairy, Market Road, submitted by Indigo Planning for Harepath LLP (the Client).

1.2 The Statement provides a prediction of the Proposed Development's improved energy baseline requirement over that of a Building Regulation compliant design through the use of energy efficiency measures, and assesses suitable renewable energy technologies in relation to the site layout, building design, energy demand and in response to the relevant planning requirements.

1.3 The statement also includes the London Borough of Richmond (LBRUT) Sustainable Construction Checklist (SCC) and details how the Proposed Development responds to, and meets, the relevant requirements as part of an overall sustainability assessment.

The Proposed Development

1.4 The Proposed Development comprises 45 No. new-build flats and 1,966m^2 of commercial space on the existing site of an unused dairy off Market Road, Richmond

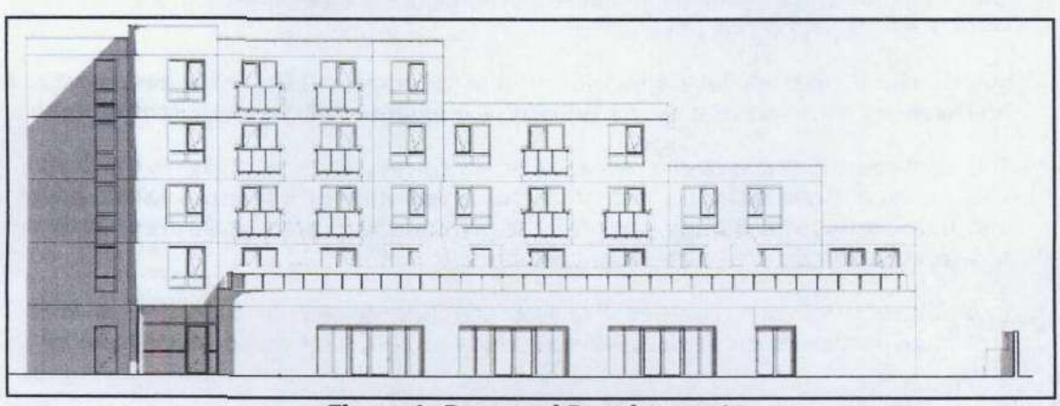

Figure 1: Proposed Development

1.5 Full details of the Proposed Development can be found in the supporting drawings (See Appendix A for proposed Floor Plans).

Sustainability Approach

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

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

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

Sustainability Guidelines and Policy

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

Key Policies

- London Borough of Richmond upon Thames' Local Development Framework (LBRUT LDF)
    - Core Strategy – Adopted April 2009
    - Development Management DPD (Publication Version) – with amendments as of July 2011.
- London Borough of Richmond upon Thames' Supplementary Planning Guidance (August 2006) – Sustainable Construction Checklist

1.9 The LBRUT LDF states that development in the Borough will create a sustainable future through:

Development Management DPD (Publication Version) - Policy DM SD 1:

"Minimising the Borough's impact on climate change including promoting the use of renewable energy, making effective use of land and resources, minimising any adverse impacts of development, encouraging sustainable building and travel."

"...New buildings should be flexible to respond to future social, technological and economic needs by conforming to the Borough's Sustainable Construction Checklist.

New homes will be required to meet or exceed requirements of the Code for Sustainable Homes Level 3.

They also must achieve a minimum 25 per cent reduction in Carbon Dioxide emissions over Building Regulations (2010)..."

Development Management DPD (Publication Version) - Policy DM SD 2:

New development will be required to comply with the Sustainable Construction Checklist and:

(a) Maximise opportunities for the micro-generation of renewable energy. Some form of low carbon renewable and/or de-centralised energy will be expected in all development, and

(b) Developments of 1 dwelling unit or more, or 100sqm of non-residential floorspace or more will be required to reduce their total carbon dioxide emissions by following a hierarchy that first requires an efficient design to minimise the amount of energy used, secondly, by using low carbon technologies and finally, where feasible and viable, including a contribution from renewable sources.

(c) Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where there is no over-riding adverse local impact.

(d) All new development will be required to connect to existing or planned decentralised energy networks where one exists.

Sustainable Construction Checklist:

All developments larger than 1-bed and/or $100m^2$ in size are expected to comply with the London Borough of Richmond upon Thames Sustainable Construction Checklist (SCC)1, with the primary target as follows:

- *Environmental Rating – Achieve Code for Sustainable Homes 'Level 3' and BREEAM 'Excellent' rating. (See Para 2.3 and Appendix C)*
- *Renewable Energy - Reduce predicted site CO_2 emissions by at least 20% through the use of on-site renewable energy. (see Section 3.0)*

Supporting Policies

- Planning Policy Statement 22 (PPS 22): Renewable Energy
- Mayor of London, The London Plan - Spatial Development Strategy for Greater London – July 2011

[1] Adopted 18th August 2006

2.0 Sustainability

2.1 The Interim Amendment to the LBRUT SPD 'Sustainable Construction Checklist' states that: *"All schemes involving 1 or more residential units, and commercial or other developments of 100m² or more, to be subject to the SCC".*

2.2 The Proposed development classifies as a 'Major Development' under the London Plan as it is above 5 units. As such, the development will comply with all requirements of the Sustainable Construction Checklist and relevant London Plan Policies

#	Theme	Checklist Item	Being Achieved	Relevant Paragraph
1	Environmental Rating	Achieve CSH Level 3 and BREEAM "Excellent"	✓	2.3
2	Site Contamination	Investigate potential contamination of the site	✓	2.11
3	Site Ecology	Undertake ecological assessment	✓	2.13
4	Energy Saving	Design building and its services for minimum energy use.	✓	3.0
5	Renewable Energy	Reduce predicted site CO_2 emissions by 20% through the use of on-site renewable energy.	~	3.63
6	Construction Materials	Specify environmentally friendly construction materials.	✓	2.15
7	Water Saving/ Recycling	Use water conservation devices and recycling techniques	✓	2.19
8	Recycling	Provide internal/external recycling facilities	✓	2.23
9	Surface Water Run Off	Prevent water pollution and overburdening of drainage systems	✓	2.27
10	Microclimate	Design out negative microclimatic effects	✓	2.28
11	Public Transport	Facilitate the use of public transport	✓	2.30
12	Cycling and Walking	Ensure development design encourages cycling and walking	✓	2.34
13	Green and Open Spaces	Enable easy access to the natural environment/open spaces and provide new and enhanced green spaces to serve the community.	✓	2.36
14	Secure Design	Adopt best practice in the secure design of the development	✓	2.39
15	Light Pollution	Mitigate light pollution	✓	2.40
16	Flood Resistant Design	Apply the principles of flood resistant design where applicable.	✓	2.26
17	Access	Ensure that the building is accessible to all	✓	2.43
18	Construction Process	*Reduce adverse impact of construction process* on quality of site and its surroundings.	✓	2.45

Table 1: Sustainable Construction Checklist

Environmental Rating – Code for Sustainable Homes

2.3 The Proposed Development will achieve Code for Sustainable Homes Level 3 certification.

2.4 The Code for Sustainable Homes is a nationally recognised standard used to assess the environmental performance of homes and aims to acknowledge improved environmental performance in house design.

2.5 The scheme considers both broad environmental concerns (e.g. climate change, resource use) as well as site specific issues (e.g. energy use, ecology etc), and these issues are balanced against the desire for high quality of life and a safe and healthy internal environment. The issues assessed are arranged into nine key categories:

• Energy	• Surface Water Run-Off	• Health & Wellbeing
• Water	• Waste	• Management
• Materials	• Pollution	• Ecology & Land-Use

Table 2: CSH Categories

Environmental Rating – BREEAM

2.6 The Proposed Development will achieve BREEAM Excellent certification.

2.7 BREEAM is a nationally recognised standard used to assess the environmental performance of non-domestic buildings and aims to acknowledge improved environmental performance in building design.

2.8 The scheme considers broad environmental concerns (e.g. climate change, resource use) and site specific issues (e.g. energy use, ecology etc). The assessment is arranged into ten key categories:

• Management	• Transport	• Waste
• Health & Wellbeing	• Water	• Land Use and Ecology
• Energy	• Materials	• Pollution
	• Innovation	

Table 3: BREEAM Categories

Specific Measures:

- Improved thermal efficiency of building envelope through improved U-Values (taken from SAP and SBEM calculations).
- Incorporation of renewable energy technologies to reduce the associated CO_2 emissions
- Provision of internal recycling facilities in-line with Local Authority recycling collection.
- Incorporation of resource efficient fixtures and fittings for energy and water consumption to reduce ongoing CO_2 emissions and encourage resource efficiency.

- Specification of materials with low embodied energy and 80% A Rated or above as per the Green Guide. Building and Finishing materials will be responsibly sourced where possible.

- Provision of information on efficient use of resources and associated appliances within the unit.

2.9 The Code for Sustainable Homes Pre-Assessment Estimate shows that the site is predicted to meet the requirements for certification to Code Level 3 (See Appendix C for summary score).

2.10 The BREEAM Pre-Assessment Estimate shows that the site is predicted to achieve an 'Excellent' rating (see Appendix D for summary score).

Contaminated Land

2.11 Environment Agency data indicates that the site is not expected to be considered as contaminated – there are no reported pollution incidences on the site or in the immediate surrounding area (Figure 2).

2.12 Additionally, there are no current or historic landfill sites in the surrounding area of the site (Figure 3).

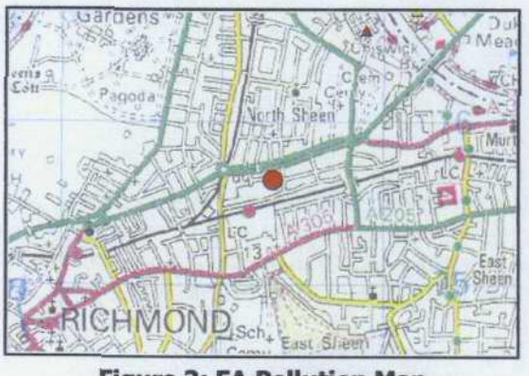

Figure 2: EA Pollution Map

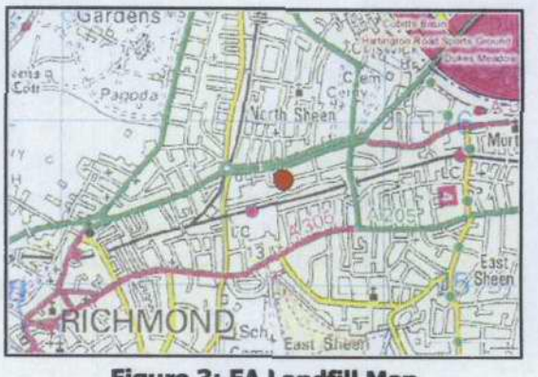

Figure 3: EA Landfill Map

Site Ecology

2.13 The site is not expected to be of ecological value – as the existing site is a disused dairy distribution centre, therefore there are no features of ecological value present on the site as it is entirely hard standing.

2.14 The new development will not increase on the existing building footprint, but it is expected that the ecological features of the communal amenity area will be increased in line with the CSH/BREEAM Assessment.

Construction Materials

2.15 The use of low environmental impact materials are being specified for the external facing/render materials and structural elements within the building design (roof, external and internal walls and floors), with a target of 80% of each element being assessed as 'A+' -> 'B' rated as per the Green Guide for Specification. No material with a rating of <D will be specified if there is a viable alternative. This will minimise the building envelopes embodied energy, associated CO_2 emissions and wider environmental impact.

2.16 Where possible, all materials will be sourced from a supplier who is covered by an accredited Environmental Management System (EMS) such as ISO 14001 or BS8555 at extraction and process stages. This will ensure that the environmental impacts of the materials have been measured and minimised where possible in the extraction and process stages of the products manufacture. Similarly, recycled materials will be utilised wherever possible to minimise the amount of raw material that would need to be obtained, and also to reduce the quantity of waste from the construction industry being sent for landfill disposal.

2.17 The development will also source all of its timber from Forestry Stewardship Council (FSC) or similar sources. Timber used in the construction process for site-use will be reclaimed, recycled or FSC.

2.18 As standard practice all insulation will achieve the relevant standards of a Global Warming Potential of <5 to ensure impacts on the climate are minimised.

Water Saving/Recycling

Internal Water Use

2.19 The average water consumption in England for metered supplies is in the region of 128L/person/day, and 132L/person/day in the Thames area[2]. The aim of incorporating internal water conservation measures is to reduce overall water usage to a maximum of 105L/person/day, in-line with the requirements of a Code for Sustainable Homes Level 3 development.

2.20 The residential units within the Proposed Development will be fitted with modern, efficient, low water use fittings, appliances (washing machines and dishwashers) and equipment to minimise water usage. A CSH Level 3 compliant water fittings schedule could comprise:

- Kitchen sink taps have a flow rate of 5 litres/min or less ('Click'/'Detent' taps can also be used)
- Bathroom basin taps have a flow rate of 4 litres/min or less ('Click'/'Detent' taps can also be used)
- Low Flow Showers (not more than 8 litres/min)
- Dual Flush WC's (4/2.6 Litre)
- Bath: Maximum 200 litre

[2] http://www.defra.gov.uk/sustainable/government/progress/regional/summaries/16.htm

- Dishwasher and Washing Machine not specified at this stage – Typical practice water use assumed.

2.21 The specification as outlined above delivers less than 105L/person/day.

External Water Use

2.22 The Proposed Development will allocate a communal amenity space for the units, as such external water storage will be provided to supply water to the soft landscaping. Water storage will provide 1 litre per $1m^2$ of residential floor space.

Recycling

2.23 The Proposed Development aims to provide recycling facilities within the new units, through the provision of internal recycling bins, adequate external bin store and the use of (and information about) the Local Authority refuse/recycling collection scheme. These measures will be assessed as part of the CSH/BREEAM Assessment and will maximise the level of recycling being achieved on the site.

2.24 Specific requirements under CSH necessitates 3 No. internal non-freestanding bin storage units with a total minimum capacity of 30l (no individual bin <7l), in a *dedicated, fixed position,* marked as for recycling.

2.25 External communal storage will be in line with the LA requirements within 30m of the external door to the Proposed Development.

Surface Water Run Off

2.26 The Proposed Development is located in an area of low flood risk, as discussed in Paragraph 2.42.

2.27 The Proposed Development will not increase the proportion of hard surface area of the site – as such attenuation devices/soakaways are not likely to be required although it is important that an initial drainage assessment is undertaken to ensure that the peak flow and annual run-off volume will be less than the pre-developed site to negate the risk of localised flash flooding.

Microclimate

2.28 The Proposed Development increases the mass compared to the existing site, due to the height of the building. This is likely to change the local air flows around the building and change the micro climatic effects.

2.29 It is unlikely that the existing, neighbouring buildings will experience any significant quantifiable negative microclimatic effects due to the Proposed Development

Public Transport

2.30 The Proposed Development is located north of North Sheen Rail Station which is approximately 550 metres safe walking distance away.

2.31 The Proposed Development is within 100m safe walking distance to bus stops on Lower Richmond Road (north) and Manor Road (west) which links to Central Richmond, Kensington and Hammersmith, with these destinations having wider links to the bus and rail network. Bus times typically operate between 0600hrs and 0000hrs, at approximately 10 minute intervals.

2.32 With this level of public transport the residents will have a viable alternative to using private transport to make local and national journeys.

Cycling and Walking

2.33 The provision of secure and covered cycle storage on site is being provided within the basement area. These will be specified for use by both the residential and office tenants in accordance with BREEAM and CSH guidance.

2.34 There are London Cycle Network routes along Lower Richmond Road and via this route and other main roads in relative proximity to the Proposed Development site and link into the wider LCN. This enables the residents to use bicycles easily and safely and provide an alternative to the use of public transport (especially during peak periods).

2.35 It is widely acknowledged that a significant reduction in harmful CO_2 emissions can be achieved through limiting the use of private vehicles for local journeys, especially when regular, local public transport is also readily accessible. As a result, the use of private vehicles will be discouraged.

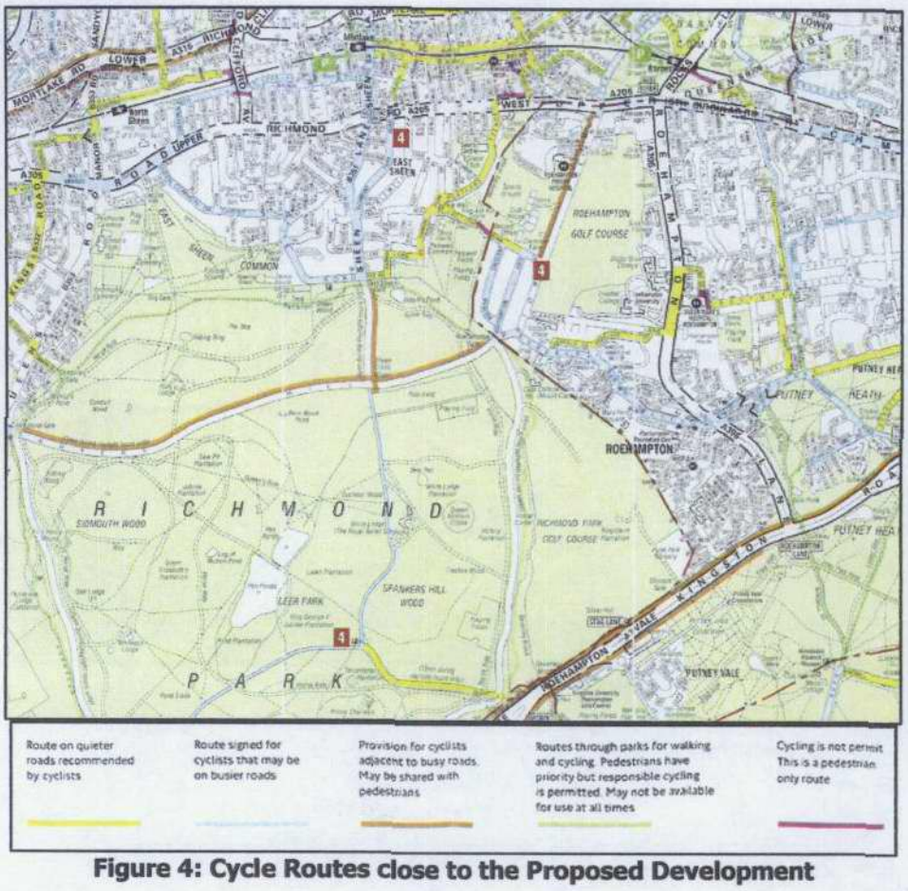

Figure 4: Cycle Routes close to the Proposed Development

Green and Open Spaces

2.36 The Proposed Development is located close to Richmond Park which has wide open green spaces and woodlands.

2.37 The site is very well located for the provision of local services and facilities, with a wide range of key facilities within the local area. Well lit pavements and safe crossing points over the main roads allow easy pedestrian access.

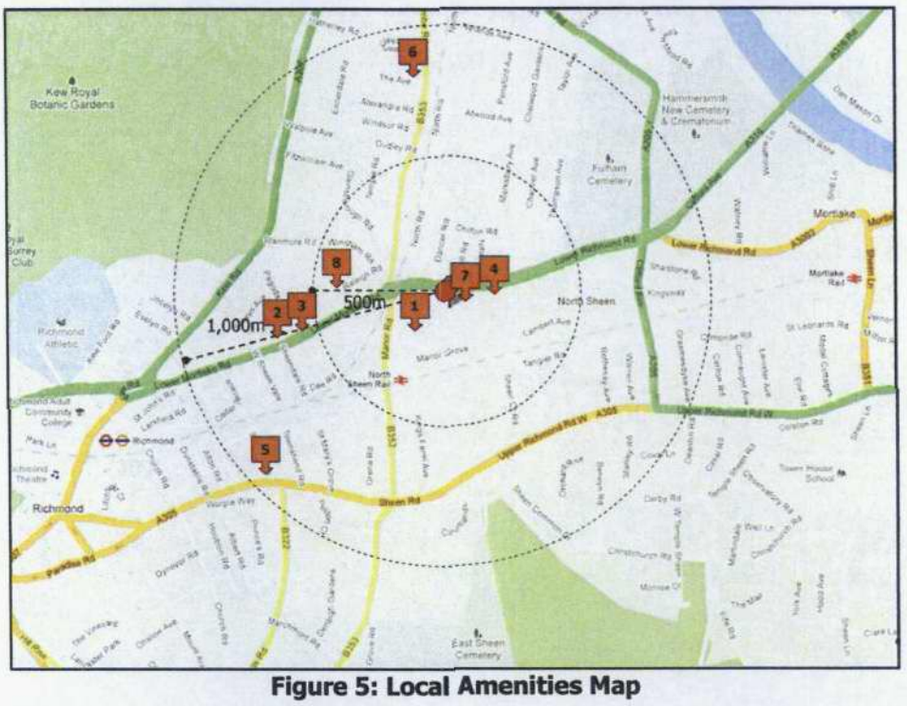

Figure 5: Local Amenities Map

Location	Key
●	The Dairy (Proposed Development)
1	Supermarket
2	Convenience Store
3	Doctor/GP
4	Post Office
5	Chemist
6	Bank
7	Public House
8	Place of Worship

Table 4: Local Amenities Key

2.38 The close proximity of key amenities to a site – ideally within 500m, and up to 1km – will result in residents walking. This greatly reduces local congestion and associated pollution and can positively enhance resident's wellbeing and health.

Secure by Design

2.39 The Proposed Development will seek advice from an Architectural Liaison Officer (ALO) regarding appropriate security measures to be adopted by the development. These recommendations will be implemented as required and where relevant and will be assessed under Secured by Design Section 2 Compliance as part of the wider CSH and BREEAM Assessments.

Light Pollution

2.40 Light Pollution will be minimised where possible through the careful specification and positioning of external lighting around the Proposed Development, ensuring that no lighting negatively impacts the surrounding residential units.

2.41 Under the guidelines of the CSH and BREEAM assessments, external lighting is controlled through daylight and PIR sensors and will consist of dedicated energy efficient fittings (space lighting) and limited wattage fittings (security lighting).

Flood Resistant Design

2.42 The application site is in an area of low flood risk based on Environment Agency Flood Risk mapping (Figure 6).

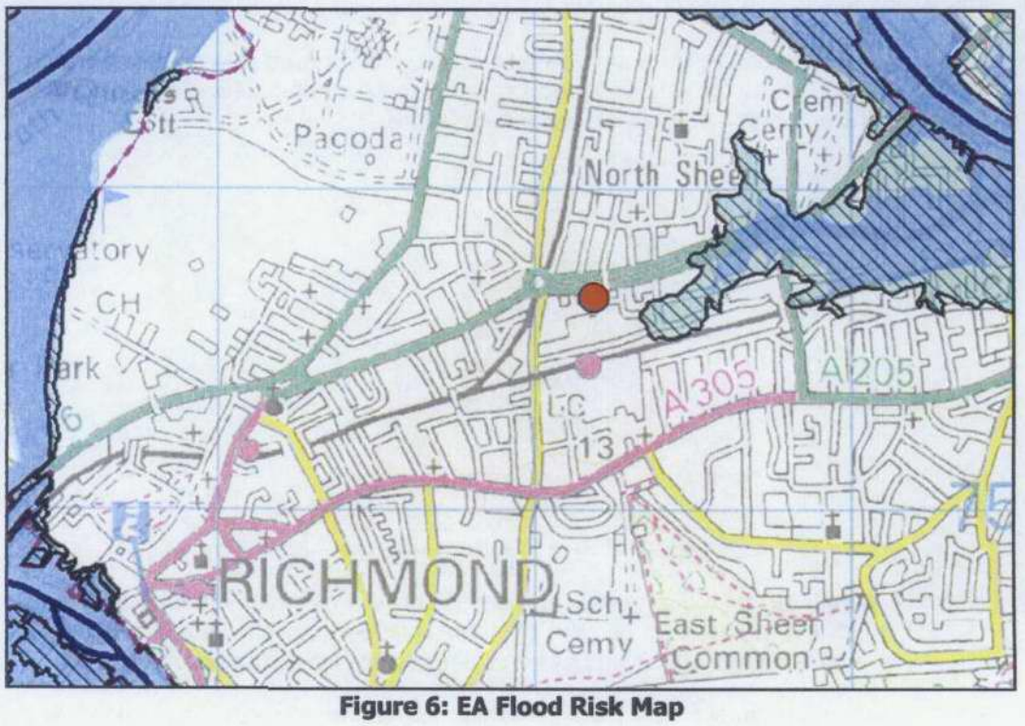

Figure 6: EA Flood Risk Map

Access

2.43 The Proposed Development consists of 2 blocks of flats and commercial space on the ground floor built on a brownfield site and as such the building has made provision for suitable access to both residential and commercial areas for all users.

2.44 The Lifetime Homes standard will be sought for the development in compliance with all requirements set out within the CSH assessment.

Construction Process

Resource Management

2.45 Construction site impacts will be monitored as standard practice in line with CSH/BREEAM as follows:

- Monitor and report CO_2 or energy use from site activities
- Monitor and report of water use from site activities
- Adopt best practice in terms of air (dust) pollution from site activities
- Adopt best practice in terms of water (ground) pollution from site activities

2.46 This will be required as part of the CSH Assessment procedure.

2.47 Wherever practicable, construction waste will be recycled/re-used in accordance with a suitable guide such as the DTI Construction Industry Key Performance Indicator (KPI) and in accordance with the waste hierarchy (see Figure 7)

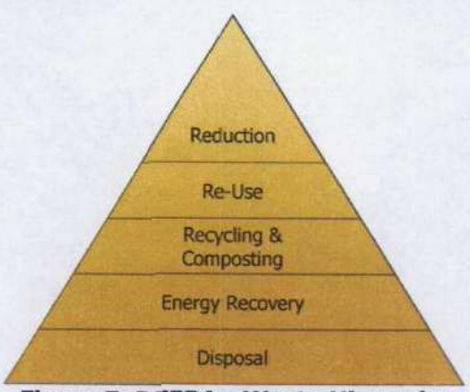

Figure 7: DEFRA - Waste Hierarchy

2.48 Where applicable this will include: monitoring of energy and water use, waste segregation, storage and removal, with the aim of seeking to minimise the negative impacts of development such as construction traffic, noise and dust pollution on site.

2.49 A Site Waste Management Plan (SWMP) will be established before construction work commences on site to monitor, report and set targets for the level of waste being re-used and recycled. This process will also be applicable for assessment as part of the CSH standards.

2.50 Appropriate monthly monitoring and waste targets will be set by the main contractor to minimise waste during the construction process – this is assessed under the Management section of the CSH.

Considerate Constructors

2.51 As part of the overall management of the site contractors will be required to sign up to the Considerate Constructors Scheme as part of their acceptance of tender.

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

2.53 The Scheme looks at the various aspects of construction work and sets appropriate standards. It covers 8 categories relevant during the construction phase of the project:

•	*Considerate*	•	Good Neighbour
•	Environment	•	Respectful
•	Cleanliness	•	Safe
•	Accountable	•	Responsible

Table 5: Considerate Constructor Categories

2.54 As part of the CSH/BREEAM Pre-Assessment a minimum score of 3 within each category, and 32 overall, will be achieved by the main contractor.

3.0 Energy Assessment

Energy Approach

3.1 The outline approach by the Proposed Development in addressing energy issues, and responding to the planning policies and guidance listed in Paragraph 1.2 above, is through minimising the building's overall environmental impact and reducing its resource use to exceed the performance standards required by Building Regulations.

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

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

3.3 The design has sought to greatly enhance the building envelope specification to minimise the overall energy demand and implementing good passive solar design where practicable.

3.4 The CO_2 Conversion Factors have been taken from Building Regulations 2010:

Fuel Source	CO_2 Conversion Factor ($kgCO_2/kWh$)	Approx. Unit Cost (£/kWh)
Electricity (mains)	0.517	£0.133
Electricity (offset)	-0.529	~£0.30-40 (feed-in)
Gas (mains)	0.198	£0.041
Heating Oil	0.274	£0.044
Biodiesel	0.047	£0.044
Wood Pellets	0.028	£0.039
Wood Chip	0.009	£0.023

Table 6: CO_2 Conversion Factors

3.5 Carbon Dioxide (CO_2) is the main greenhouse gas[3] that is deemed responsible for anthropogenic climate change[4]. Although by mass it does not have as high radiative forcing effect as other gases (namely CH_4 – Methane), the sheer quantity released through combustion means that, overall, it has the most effect. It is also one of the more controllable – it can be directly controlled through reductions in fossil energy use.

3.6 It is also equally important in an era of ever increasing total energy consumption to increase energy efficiency in order to minimise dependency on, and conserve existing supplies of fossil oil and gas, which are estimated to be at, or close to, their peak of supply[5]. After this peak, production, and therefore availability, is expected to steadily decline resulting in fuel cost increases.

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

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

[5] More information, references and peer-reviewed articles at http://www.peakoil.net & http://www.odac-info.org

Baseline Energy Predictions – Building Regulation Compliant

3.7 For the purposes of baseline energy predictions the site has been considered as a number of distinct areas: B1 (for the commercial space) and residential units (1-3 bed).

3.8 The development will achieve Building Regulations 2010 compliance as a minimum before the use of renewable technologies.

3.9 Building Regulations now include a large number of the improvements that would previously have been included within the Predicted Energy Baseline specification. As such, although the SAP process still generates a minimally Building Regulations compliant Baseline (TER), it is only a notional figure that is derived to show that the actual specification (DER) is compliant and is not useful for a direct comparison of energy use.

3.10 Therefore, the energy conservation and energy efficiency measures detailed below are utilised as part of the Predicted Energy Baseline, detailed in Table 8.

Energy Conservation Measures (be lean)

3.11 The overall energy strategy for the Proposed Development, as highlighted in paragraph 3.1, will be to use less energy, use clean energy and use renewable energy and to, where possible, design an energy conscious building to positively influence the overall predicted energy demand.

3.12 A number of energy conservation measures will be incorporated by the Client to reduce the overall energy load for the Proposed Development. This is in-line with both the Policies listed above in Paragraph 1.8 onwards as well as general national 'Best Practice' guidance for delivering energy efficient buildings.

Passive Solar Design

3.13 The Proposed Development is orientated with its long elevations facing N/S, as such most units will benefit from the passive solar gain to a certain extent across the E/W elevations as the sun tracks across the sky. As such, window openings will be maximised as much as practical to enable the units to benefit from passive solar warming.

3.14 The use of positive thermal mass in the building structure as part of the external and party wall construction will also help to improve the insulation standards and will minimise potential overheating issues within the south facing rooms in summer months. Due to the limited number of units directly south facing, the overheating risk will be minimal.

Natural Daylight & Ventilation

3.15 The provision of natural daylight and ventilation are important factors to consider in the design in order to minimise the use of artificial light and mechanical ventilation.

3.16 Natural pressure differential between two opposite elevations of a building will lead to a 'draw-through' of air in each unit. However, many units have single elevations and do not feature openings on opposite elevations which will reduce the level of natural

ventilation. In order to increase the level of natural ventilation, all window openings will be specified to have large openable areas.

3.17 Adequate window openings have been provided to all units to maximise natural day lighting, and therefore help reduce the internal lighting load. These will allow for daylight and ventilation. However, the use of extensive large glazed areas for south facing elevations do face the risk of internal over-heating from excessive solar gain and will be assessed as part of Building Regulation compliance to avoid overheating risk.

3.18 Where mechanical ventilation is required under Building Regulations, heat recovery (MVHR) may be required. These ventilation systems extract the latent energy from the warm expelled air and use it to preheat the incoming, cooler air from outside – this reduces heat loss and also helps reduce the 'pluming effect' often associated with standard mechanical ventilation systems expelling moist, warm air into the local atmosphere.

3.19 Windows will be specified with low E, high transmission glazing, thereby maximising the light levels into the internal spaces whilst minimising heat loss from the window openings.

3.20 The commercial space will make use of Air Source Heat Pumps to provide space heating and, as part of the ventilation strategy, will evaluate the use of heat recovery systems within the overall design.

Insulation and Air Tightness

3.21 Insulation levels have been modelled to ensure that the space heating load will be reduced from the Part L baseline condition. In addition a reduction in space heating requirements would be provided through reduced air changes.

3.22 Where possible, the Proposed Development will incorporate high performance insulation in the building envelope (walls, roofs and windows) to achieve an average U-Value as detailed below:

Element	Proposed U-Value	Example Spec.
Floors/ Ceiling	0.14	Timber decking and joists with glasswool/PU Board insulation
External Walls	0.13/0.14	Timber decking and joists with glasswool/PU Board insulation
Basement Floor	0.2	Assumed Basement Value
Windows	0.9	Triple Glazed Argon Filled
Doors	0.9	Timber, with aluminium framing.

Table 7: Proposed U-Values

3.23 Air tightness has been estimated as achieving a rate of ~3-4m^3/hr/m^2, and will be tested as part of Building Regulation compliance and to inform final As-Built SAP and SBEM

Thermal Bridging

3.24 Thermal bridging is the process by which materials that directly connect the internal and external walls of a building (e.g. *lintels and wall* ties) transfer warmth out of the building through conduction.

3.25 Through careful selection of materials and construction techniques, it is possible to reduce the level of thermal bridging apparent within the walls. This decreases heat loss and increases the Fabric Energy Efficiency (FEE) of the building - assessed under Building Regs 2010.

3.26 Accredited Construction Details are useable under the new building regulations, however for achieving enhanced levels, psi values will need to be calculated for the specific materials junctions by a suitably qualified person. It is expected that the development will utilise Enhanced Construction Details (0.04) to further reduce thermal bridging.

3.27 Through attention to detail around materials junctions (e.g. floor edges) and the use of building materials such as cobalt wall ties, the level of thermal bridging can be reduced.

Voltage Optimisation

3.28 The use of a Voltage Optimiser/Regulator in the main supply the building would allow for all electrical appliances to operate more efficiently. Voltage in the UK can fluctuate between ~220-253V – UK appliances are designed to work at their most efficient at around 220V, above this they will still function perfectly but energy is lost in heat and noise.

3.29 The regulator operates by maintaining a steady 220V regardless of input, allowing for all equipment to operate at maximum efficiency. It is difficult to quantify the energy reductions as it will differ greatly from appliance to appliance, but it is stated that a regular house will experience reductions in electrical use of up to ~10%[6]. This technology is recommended for installation within the Proposed Development.

Energy Efficient Lighting and Appliances

3.30 The Proposed Development will make use of low energy lighting in-line with BRE methodology and in excess of Building Regulation requirements. Incandescent bulbs are now being phased out through minimum energy efficiency ratings and larger wattage bulbs are now not available, with all traditional-style filament light bulbs likely to be non-compliant by Sept 2012. By the time that the Proposed Development is finalised and under construction, most bulbs are likely to be inherently energy efficient. As such this has been included within SAP modelling.

3.31 The commercial space will be specified with high frequency ballast, T5 lighting with PIR and zone controls as standard to minimise energy demand from internal lighting.

3.32 Although appropriate appliances are expected to be fitted - 'A' or 'A+' White Goods (where possible), advice will also be provided as part of the Home User Guide detailing

[6] Information from http://www.vphase.co.uk - example only and does not constitute a product endorsement.

the benefits of energy efficient appliances. Based on the BRE calculation methodology these measures will reduce electrical demand by ~10% - although it is not possible to calculate any reductions at this stage or through the Standard Assessment Procedure.

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

Exhaust Air Heat Recovery System

3.34 Exhaust Air Heat Recovery systems (EAHR) are designed to recover both heat from the flat and use an air source heat pump approach to generate heating and hot water for the tenants. They are especially efficient in well insulated apartment blocks where the heating load is significantly reduced de to the performance of the building envelope.

High Efficiency Gas Condensing Boiler

3.35 In the Predicted Energy Baseline all residential units will be specified with a high efficiency gas combination boiler system (SEDBUK A rated) to provide all the space heating and hot water supply. Therefore the heat source is able to deliver greater CO_2 savings, as well as reduced NO_x emissions (target ≤40mg/kWh to support CSH Assessment).

Flue Gas Heat Recovery System

3.36 Flue Gas Heat Recovery systems (FGHR)[7] are designed to recover heat from the condensate and flue gases discharged from a combination boiler. They pre-warm the cold water supply to the boiler thereby increasing the boiler's efficiency and ability to provide hot water supply to a number of fittings simultaneously without loss of temperature or flow rate.

3.37 In addition, the FGHR system can incorporate a concentrated thermal store – this is a very small hot water cylinder which allows the combination boiler to more efficiently provide hot water as per a conventional system boiler, but without the standing losses associated with a large cylinder or the space requirements.

3.38 The result is that the boiler can save up to 30% of the heating energy demand compared to a standard high efficiency gas boiler. FGHR is proposed for use and included within the SAP Calculation.

Influence Energy Behaviour

3.39 The Proposed Development would be provided with a Building User and Home User Guide which will detail how to effectively use all the appliances and fittings installed and thereby minimise associated energy use and CO_2 emissions. This information will inform the residents on how to gain maximum benefit from the appliances and energy systems provided and will help to positively influence their long term energy behaviour.

[7] Such as the Zenex GasSaver – Example only and does not constitute a product endorsement

3.40 Energy meters will also be provided so as that the residents can monitor the amount of energy used within the dwelling – energy meters can log the electricity and gas usage of a building, provide cost breakdowns and indicate if excessive energy is being used at any point. These systems allow the end user to take control of their energy use, allowing them to cut their costs and CO_2 emissions.

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

Improved Baseline Energy Prediction

3.42 The following energy baseline has been calculated taking into consideration the positive impact of the improved design and the energy efficiency measures listed above.

3.43 SAP 2009/SBEM and Building Regulations 2010 have been used to generate the energy baseline:

Type	Total Floor Area (m^2)	*Electrical Demand (kWh/yr)*	*Heating & Hot Water (kWh/yr)*	*Appliances & Cooking (kWh/yr)*	Baseline Energy (kWh/yr)	Baseline CO_2 emissions ($kgCO_2/yr$)
Residential	2,716	24,679	67,452	78,743	170,965	66,843
Commercial	1,966	98,635	105,677	-	204,313	105,630
Total	**4,682**	**123,284**	**173,129**	**78,743**	**375,278**	**172,473**

Table 8: Baseline Energy Prediction

Incentive Schemes

3.44 The annual savings detailed in the following assessment of low carbon and renewable energy feasibility are calculated using the Feed-In-Tariff (FIT) and Renewable Heat Incentive (RHI) schemes.

3.45 FIT is available now, where RHI is not set to be adopted until July 2012 for domestic systems (with interim grant system – Premium Heat Payments), although schemes implemented now will be able to join the scheme when it becomes active.

3.46 The schemes aim to provide financial support to individuals, communities and businesses to encourage them to implement renewable/low carbon technologies. An elevated rate is paid for all energy generated on-site by renewable or low carbon means.

3.47 Further details on the schemes and the associated tariffs are provided in Appendix D.

Energy Supply (be clean)

Combined Heat and Power

3.48 The predicted year-round domestic hot water demand for the Proposed Development makes the use of Combined Heat and Power (CHP) plant technically feasible for this site.

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

3.50 An example of a suitably sized CHP would be the Dachs SE Micro-CHP[8], which is rated at 5.5kW electrical output, 13.4kW hot water output and an overall efficiency of 86%.

3.51 Based on the predicted hot water requirement of the units as calculated from SAP, and a 10hr/day operation, there is an average hot water demand of approximately 21kW – as such the viability of the system is probable as the system is likely not to 'cycle' when the hot water use falls below 12.5KW for an extended period.

3.52 It is important that the CHP is sized so as that it will still be running at maximum load (and therefore high efficiency) during the summer when there is low heating load – therefore the CHP is only sized for the summer domestic hot water load and not to provide the entire heating load or electrical demand. The system would require a standard gas boiler backup to cater for periods of heavy load and to provide the space heat requirement.

3.53 Annually the system is predicted to provide 48,910 kWh/yr of heating (space heating and hot water) and 20,075 kWh/yr of electricity.

3.54 Taking into account the CO_2 offset value of 0.568kg CO_2/kWh for on-site electrical generation, a CO_2 saving of 0.374kg CO_2/kWh is generated via gas fired CHP.[9]

3.55 The efficiency of a 'Good Practice' boiler system is approximately 86%, therefore the use of 1 No. micro CHP system will offset approximately 8,801 kgCO_2/yr **– equivalent to a 2.8% saving in predicted CO_2 emissions.**

3.56 However, due to the relative inefficiency of a CHP unit when compared with a gas boiler, fuel consumption is expected to increase by 3.8% - this is an overall increase in energy use of 1% (when taking into consideration the electrical energy generated on-site). It is recommended that a full CHP Feasibility Study detailing expected load patterns is commissioned post planning to support this initial assessment.

The use of Heat Pump Technology

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

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[8] Example of appropriate technology – this does not constitute a product endorsement

[9] 0.568kg CO_2/kWh minus 0.194kg CO_2/yr gas used in CHP equals NET CO_2 saving of 0.374kg CO_2/yr (although this does not take into account the efficiency of a comparable gas boiler)

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

3.59 This contradicts the general approach to energy reduction, which should be to minimise emissions as much as possible before the generation of on-site energy.

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

- Using underfloor heating (or a low temperature radiator system)
- Allowing space for plant within the design

3.61 It is possible to use a heat pump for the heating supply and a separate gas boiler for hot water demand. This maximises the performance of both technologies and minimises their environmental impact.

Renewable Energy Assessment (be green)

3.62 Based on the Energy Assessment and the subsequent Predicted Improved Energy Baseline in Table 8, a total of 34,494 $kgCO_2/yr$ would be required to be offset through on-site renewable energy sources to meet the requirements of The London Borough of Richmond upon Thames CS, and in-turn the requirements of the London Plan for a 20% reduction/offset in the predicted CO_2 emissions through the use of on-site renewables.

3.63 Table 9 below summarises the various renewable energy solutions that have been assessed for the Proposed Development. Further, technical details are shown in Appendix D for all the renewable energy technologies assessed, including warranty and payback information.

Technology	Technically Feasible	CO_2 Offset ($kgCO_2/yr$)	Benefits	Weakness
Photovoltaics	✓	34,469 (20.0%)	High CO_2 offset and proven technology	Higher capital cost than other solar technologies
Solar Water Heating	×	×	Efficient and integrates with a domestic heat pump	Lower CO_2 offset as replacing gas supply
Hybrid PV/SWH	✓	×	High CO_2 offset levels and minimal roof use and complimentary technologies	Limited overall size due to thermal aspect and immature technology
Ground Source Heat Pumps	×	×	Provides space heating and a proportion of domestic hot water dependant of gas	Low CO_2 offset, ground conditions dependant, borehole drilling costs.
Air Source Heat Pumps	✓	~1,600 (0.8%)	Provides space heating and a proportion of domestic hot water dependant of gas	Low overall CO_2 offset. Potential system noise
Biomass Boiler	×	×	Low CO_2 emissions	Fuel storage space & fuel cost, regular supply of fuel
Biomass Stoves	×	×	Provides secondary heating with low CO_2 emissions	Fuel storage space & fuel cost, regular supply of fuel
Wind Turbines	×	×	Strong visual positive impact	Poor local wind resource and potentially intrusive

Table 9: Summary of Renewable Energy Assessment

Roof Layout

3.64 The building features a flat roof arrangement with the ridge line orientated on an N/S axis.

3.65 The site plans indicate that there will be no shading risk on the roof areas highlighted. However green roof spaces may be lost to maximise the PV output of the development.

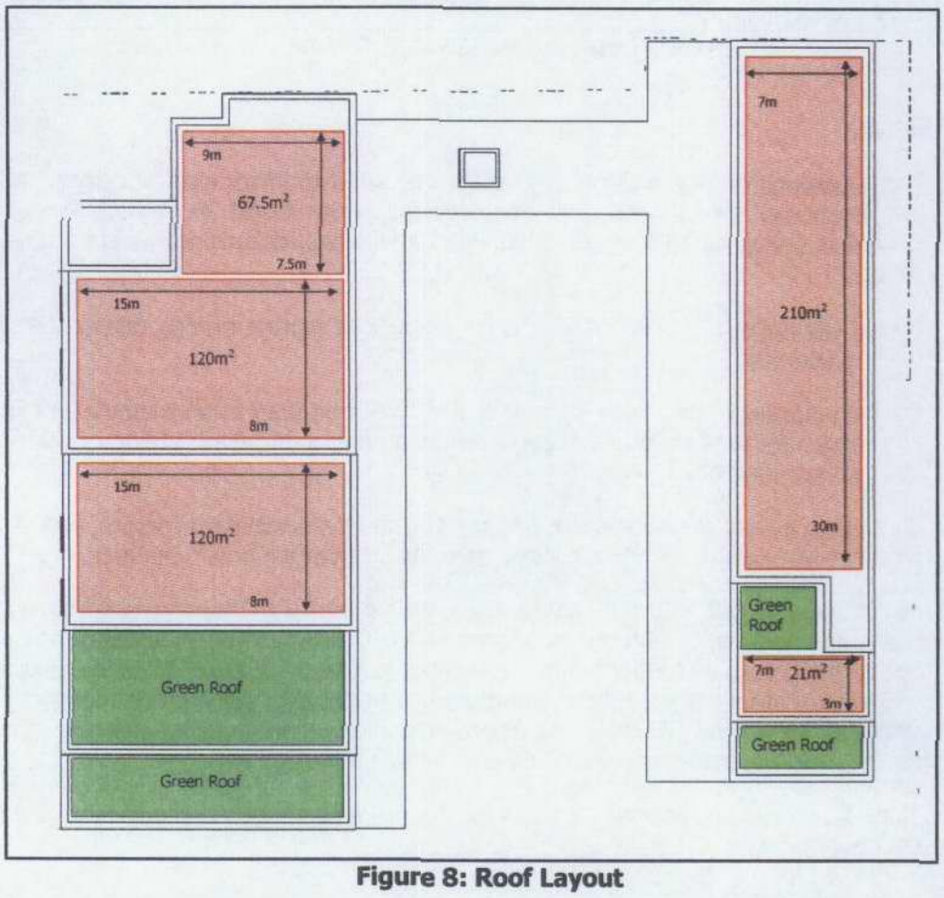

Figure 8: Roof Layout

Location	Width (m)	Length (m)	Area (m^2)	Inclination	Orientation
Flat roof	7.5	9.0	67.5	10°	0° S
Flat roof	8.0	15.0	120	10°	0° S
Flat roof	8.0	15.0	120	10°	0° S
Flat roof	7.0	30.0	210	10°	0° S
Green Roof	3.0	7.0	21	10°	0° S

Table 10: Roof Areas - Key

Viable Energy Technologies

3.66 A number of renewable energy technologies are technically viable, although any potential design and structural issues would need to be clarified in relation to the finalised design. Payback and lifecycle carbon offset is included in Appendix D.

• Photovoltaics	• Air Source Heat	• Biomass
• Solar Water Heating	• Ground Source Heat	• Wind Turbine
• Hybrid SWH/PV		

Table 11: Assessed Renewable Technologies

Photovoltaics

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

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

3.69 For the purposes of this study a Yingli YL 235[10] will be used as an example of a module PV system for the flat roof. Each panel covers an area of 1.64m^2 (1.65m x 0.99m) and has a peak output of 235W.

3.70 Based on the roof areas detailed in Table 10, and the initial roof layout, Block A and Block B will maximise the PV size including some loss of the green roof area.

3.71 As outlined in Table 10 the PV arrays would be set on a 10° frame/console to maintain minimum performance efficiencies and warranty, therefore the PV efficiency has been set at 96%. Based on the roof areas highlighted in Figure 8, Block A has the capacity for ~43.8kWp (140 modules) PV array and Block B (including some green roof space) has capacity for ~33kWp (75 modules). These areas are representative of what is required for the development to achieve a 20% offset solely through PV.

3.72 Table 12 shows the required PV areas for the residential area and commercial areas of the development.

Type	Array Size (kWp)	Energy Generated (kWh/yr)	CO_2 Offset ($kgCO_2/yr$)	% Energy Offset	% CO_2 Offset
Residential	30.21	24,767	13,102	14.5%	19.7%
Commercial	49.50	40,392	21,367	19.8%	20.3%
Totals	**79.71**	**65,159**	**34,469**	**17.4%**	**20.0%**

Table 12: PV Array Sizing - CO_2 Offset

3.73 The analysis in Table 12 indicates that the LBRUT CS target for 20% offset of total predicted CO_2 emissions can be achieved solely through the use of PV.

[10] Information from http://www.yinglisolar.com - example only, this does not constitute a product endorsement.

Air Source Heat Pump

3.74 Commercial office space will primarily make use of ASHP technology for space heating and cooling as it is the most efficient method of providing heating (and ventilation) to all areas of the building whilst responding to different internal uses and layouts.

3.75 The use of 3-pipe Variable Refrigerant Flow (VRF) air source heat pump within the office units would provide both heating and cooling for the office space. VRF technology would reduce the overall heating demand by moving heat from areas where it is in excess to where it is needed. Through the zoning of the systems and appropriate controls, efficient energy supply will be achieved across the site.

3.76 ASHP are most suited to modular or highly cellular office areas with simultaneous demand for heating and cooling. The use of EAHR will be investigated as these systems feature no external condensers and hence the roof areas can be maximised for PV.

3.77 It is intended to install ASHP to provide space heating within the commercial sectors of the building. Data is not available to allow the performance of ASHP to be assessed against a gas baseline for this building - CO_2 offset is predicted to be relatively low against a high performance gas baseline at ~0.8-1.0% (~1,600 $kgCO_2/yr$).