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Evidence Base for Basements and Policy CE1: Climate Change

Royal Borough of Kensington and Chelsea

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Date:
03.07.2013

Our Ref:
E514-report-130703-dp

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Introduction

The Royal Borough of Kensington & Chelsea (RBK&C) is seeking advice and recommendations as an Evidence Base for a revision to Core Strategy Policy CE1 of their Local Development Framework. A primary reason for the revision is that the policy tool EcoHomes is becoming obsolete and being replaced by BREEAM Domestic Refurbishment. The assessment method was used in Policy CE1 as the tool to regulate the sustainable refurbishment of residential development that include basements. The aim of the policy revision is to implement an appropriate BREEAM Domestic Refurbishment standard equivalent to the EcoHomes standard. The policy objective is for the additional embodied carbon emissions as a result of basements to be offset through environmental improvements to the original residential or commercial building to which the basement relates appropriate to the historic environment.

In line with the Brief (see section 2), the proposal is to provide an Evidence Base for the revision of Policy CE1, by analysing the current Policy CE1 and then determining its equivalent under BREEAM Domestic Refurbishment (BDR), in line with policy objectives. The methodology is to use a variety of case studies to determine an appropriate policy for residential subterranean development of listed and non-listed buildings, major developments and new build with subterranean development. The analysis will provide recommendations for the policy for carbon emissions, water use, materials, waste and BREEAM rating. In addition, policy implementation advice will be provided, including supportive text on likely design implications.

Aim

The aim of the evidence base is to:

- Recommend an appropriate revision to RBK&C's basements policy and Policy CE1 given that EcoHomes is obsolete for future development;
- Choose an appropriate tool to make carbon savings to mitigate the embodied carbon impact as a result of basements;
- Ensure that the policy is suitable for historic buildings, including Listed buildings with measures discussed in line with Heritage Checklist, see appendix 2; and
- Recommend policy targets for carbon, waste, materials, water and BREEAM rating.

1. Executive Summary
Evidence Base for Basements and Policy CE1: Climate Change

Policy Recommendation

BREEAM Domestic Refurbishment (BDR) is the appropriate assessment method to replace EcoHomes as the policy tool for residential refurbishment. The recommended policy target is a 'Very Good' rating with additional minimum standards to meet the policy objectives.

The recommended tool for a minimum carbon emissions requirement is the minimum standards in BDR. To provide additionality of carbon saving measures, it is recommended to set a minimum standard of 'Excellent' under the Energy section for the policy to meet the RBK&C's objectives. The minimum standard for Excellent is applicable to un-Listed and Listed buildings, subject to building fabric measures applicable in the Heritage Checklist, see appendix 2.

Where developments include historic fabric (whether listed or not), the council **recommends that fabric upgrades do not harm historic features either through careful renovation or by focusing on service improvements**. The environmental assessor and historic building consultant should examine the existing fabric of a development and confirm that the proposed upgrades do not harm these historic features.

The recommended waste target is a requirement that 80% of the percentage points available in the waste category are achieved, thereby requiring 70% of construction waste and 80% of demolition waste to be diverted from landfill.

For all new build residential development with basement, it is our recommendation to set a policy target of a Code for Sustainable Homes Level 4 rating, which includes minimum standards for carbon, water and waste.

The following provides a summary table of the recommendations for the policy:

	BREEAM Rating	Carbon Target	Waste Target	Water Target
Residential refurbishment including new basement	Very Good	Minimum standard for Excellent - SAP Rating of 70	80% of un-weighted credits in the waste category	Minimum standard for Very Good
Residential refurbishment constituting major development	Excellent			
New residential development with basement	Code for Sustainable Homes Level 4			

2. Brief

Evidence Base for Basements and Policy CE1: Climate Change

Brief

RBK&C requires provision of an analysis of RBK&C LDF Policy CE1's switch from EcoHomes to BREEAM Domestic Refurbishment (BDR) as a environmental assessment methodology for residential subterranean development and major developments. The objective is to ensure equivalence between the current policy and a future update following EcoHomes's replacement by BDR. The overall context is also a general update to the LDF Policy CE1 in conjunction with a review of the planning policy for basement development.

The brief calls for the following to be undertaken:
- Confirm equivalent policy for following building types: a) Basement development as defined by the draft basements policy, b) Basement development of Listed Buildings, c) New Builds with basement development, d) Residential development of more than 1000 m^2.

- Establish an appropriate BREEAM level that could reasonably be expected to be achieved, whilst preserving the historic significance of listed buildings.

- Confirm equivalent policy for following sustainability aspects including what 'percentage' of points under carbon in particular to require, to ensure the primary purpose of the policy as a carbon management measure:
    - Carbon Emissions;
    - Water Usage;
    - Materials;
    - Waste; and
    - Overall BREEAM rating.

- Provide requirement to ensure appropriate implementation of policy including guidance on documents and certification requirements at various stages.

- Provide supportive text on design measures to be considered when meeting policy targets for historic buildings including ventilation, thermal bridging, interstitial condensation and windows.

3. Methodology
Evidence Base for Basements and Policy CE1: Climate Change

Introduction

This section sets out the previous work undertaken to inform Sustainability Policy and the methodology adopted here to meet the brief.

Previous discussions

The analysis process started with a series of workshops involving RBK&C's Design and Conservation Team and Policy Team. Several case studies were identified that reflect the type of existing stock within the Borough. Discussions were held on the possible measures to refurbishing RBK&C's existing housing stock to achieve improved energy performances. The key output of this stage was a 'Heritage Checklist' (see appendix 2) setting out the allowable carbon saving measures on buildings in a Conservation Area and Listed buildings.

Further analysis was then undertaken to determine a suitable EcoHomes target for residential refurbishment in the Borough. Three case studies were used and a target Very Good rating under EcoHomes was set, including a minimum 40% of energy, water and waste credits. The key output was an evidence base for using EcoHomes as a policy tool for residential refurbishment.

With regards to basements, a comparative analysis was undertaken to investigate the carbon emissions of subterranean development versus extension above ground. The key output from this study was that basements have significant embodied carbon in comparison to extensions of masonry construction.

The current brief is therefore based on investigating the revised policy option for basements, given that EcoHomes is now obsolete. The following table sets out the methodology:

Methodology

Steps:	Section of report
1. Choose case studies to match building categories to be impacted by policy.	4
2. Analyse case studies to test policy objectives.	8
3. Analyse Listed Buildings to clarify impact of policy on likely elements of significance.	8
4. Provide policy recommendations based on analysis covering carbon, water, waste and BREEAM rating.	5
5. Set-out guidance on policy implementation at each stage of development, including supportive text covering sustainable design in a heritage context.	6 and 7

4. Building Types
Evidence Base for Basements and Policy CE1: Climate Change

Introduction

The policy objective is to implement targets proportional to the heritage significance and the size of the scheme. The categories of buildings the policy relate to are included in the table below. To test these categories, three buildings have been used as case studies to analyse the policy implications. For each building, the measures that are permissible from a heritage perspective have been selected from the Heritage Checklist in appendix 2, which provides the likely heritage impact of a basket of environmental measures such as internal wall insulation and thermal upgrading of windows. Note that all Listed Buildings are to be taken on a case by case basis; the Heritage Checklist (see appendix 2) is considered what may be acceptable on a Listed Building.

The table below describes principal characteristics of the three case study types. Where a case study is Listed, the permissible measures have been taken from the Heritage Checklist in appendix 2.

Case Studies Numbering	Unlisted	Listed
Godfrey Street	1	2
Cadogan Place	3	4
John Street	5	Not Applicable

Testing of Policy Targets

The categories of buildings to be tested as part of this evidence base are provided below and the corresponding applicable case study.

Policy Targets	Case Studies Used
Unlisted building including new basement	1, 3
Listed building including new basement	2, 4
Residential refurbishment constituting major development	5
New residential development with basement	Untested

5. Policy Recommendations

Evidence Base for Basements and Policy CE1: Climate Change

Introduction

The recommended policy is provided in the table below. A summary of the implications for carbon, water and waste is provided in this section.

	BREEAM Rating	Carbon Target	Waste Target	Water Target
Residential refurbishment including new basement	Very Good	Minimum standard for Excellent - SAP Rating of 70	80% of un-weighted credits in the waste category	Minimum standard for Very Good
Residential refurbishment constituting major development	Excellent			
New residential development with basement	Code for Sustainable Homes Level 4			

BREEAM Rating

The recommendation is for either a BREEAM Domestic Refurbishment Very Good or Excellent rating, depending on the size of scheme, with minimum requirements in carbon, water and waste. For unlisted and listed buildings with a basement the recommendation is for a BREEAM Very Good to be achieved. For residential refurbishment or conversions constituting major development, a BREEAM Excellent is the recommended target. For non-residential refurbishment or conversions constituting major development, the recommendation is for a Very Good rating to be set as the policy target.

Carbon Target

As a minimum standard for carbon, BDR uses the 'Post Refurbishment Energy Efficiency Rating' (EER), which is equivalent to the SAP rating from the SAP calculations, to be produced for Building Regulations Part L : Conservation of Fuel and Power.

For unlisted buildings with a basement a minimum SAP rating of 70 is required, which can be achieved through **efficient services with roof insulation** and / or fabric improvements in keeping with the historic nature of the fabric. For Listed buildings including a new basement, the minimum requirement of 70 can be achieved through upgrading the building service systems as well as additional roof insulation. Note that the requirements for upgrades to Listed Buildings are to be considered on a case by case basis.

Waste and Water Target

For waste, the minimum target requires 70% of construction waste and 80% of demolition waste to be diverted from landfill. The minimum target for water requires a minimum of 139 litres per bedspace per year of internal water usage, through water efficient sanitaryware.

New Residential Development with Basement

For new build residential, the recommendation is to achieve a Code for Sustainable Homes Level 4 for all new residential development with basement.

Offset Scheme

An offset scheme is not proposed for Listed buildings.

6. Policy Implementation

Evidence Base for Basements and Policy CE1: Climate Change

Introduction	Further to the policy recommendation, the following is the detail of the recommended for the policy wording.
Policy Wording	All residential refurbishment developments with a basement are to achieve a BREEAM Domestic Refurbishment Very Good rating including the following minimum standards: • Meet the minimum standard of Excellent for Energy; and • Achieve at least 80% of the un-weighted credits in the waste category. All residential refurbishments or conversions constituting a major development, a net internal floor area of over 1000 m^2, to achieve an Excellent BREEAM Domestic Refurbishment rating including the following minimum standards: • Meet the minimum standards of Excellent for Energy; and • Achieve at least 80% of the un-weighted credits in the waste category. All non-residential refurbishments or conversions constituting a major development, a net internal floor area of over 1000 m^2, to achieve a Very Good BREEAM rating. All new residential development with basement to achieve a Code for Sustainable Homes Level 4 rating. Where developments include historic fabric (whether listed or not), **the fabric upgrades should not harm historic features either through careful renovation or by focusing on service improvements**. An environmental assessor and historic building consultant should examine the existing fabric of a development and confirm that the proposed upgrades do not harm these historic features.
Pre-application Stage	Planning Officer to make the applicant aware of the BREEAM target, with particular emphasis on larger basements where there are higher targets.
Planning Submission	All applications to include a BREEAM Domestic Refurbishment preliminary assessment by a licensed assessor identifying the credits likely to be achieved and the rating targeted.
Planning Condition	Planning condition to require a post construction stage certificate to be provided to the local authority prior to occupation. Suggested wording: "No occupation shall commence without the provision of a BREEAM Domestic Refurbishment post construction certificate applicable to the site to the Local Authority demonstrating that the target rating and minimum standards have been achieved."
Pre-Start Requirement	A suggestion is to include a pre-start condition to provide a revised preliminary assessment by a licensed assessor confirming the targeted rating and credits.
Prior to Occupation	Verify that the Post Construction BREEAM Domestic Refurbishment certificate is provided prior to occupation.

7. Supportive Text
Evidence Base for Basements and Policy CE1: Climate Change

Introduction	It is suggested that the following is included as supportive text to the policy, to allow design and conservation officers to inquire as to whether sustainable refurbishment has been undertaken in an appropriate way. The text relates to ventilation, condensation and breathability of construction.
Summary	In order to achieve the 'Post Refurbishment Energy Efficiency Rating' (EER) or SAP rating recommended in the policy update, services upgrades and / or fabric improvement measures will be required. **Note that the recommended carbon target does not require whole house internal wall insulation as alternative routes are available to meet the targets including upgrading the roof insulation, heating and other building services**. It is important to consider the potential impact that building fabric improvement measures and their construction would have, both on the significance of the heritage asset and on the long term performance and integrity of the building fabric.
1.0 Proportionality and the impact on significance of the heritage asset	1.1 The principle that building fabric improvement measures are proportional to the significance of the heritage asset should be established. 1.2 The impact of improvement measures upon the significance of the heritage asset should be addressed in the applicants Design and Access Statement and/or Heritage Impact Statement. 1.3 Officers should weigh the impact of the proposed fabric improvements upon the significance of the heritage asset with the principle of proportionality in mind: the greater the significance of the heritage asset the lower the acceptable impact of fabric improvements. The capacity of existing buildings to sustain fabric improvements in order to meet the policy requirements should be assessed with reference to National Planning Policy Framework (NPPF) and its definition of and presumption in favour of sustainable development. 1.4 Given that much of the Royal Borough of Kensington & Chelsea comprises Conservation Areas, it is likely that the majority of acceptable building fabric improvements will be internal, with the potential exception of improvements to windows. 1.5 Significance and proportionality are key: For example, internal wall insulation may not be appropriate where significant plaster moulding and joinery would be lost or disturbed during, or as a result of installation, even in a non listed building within a Conservation Area, provided it is demonstrated that the moulding and joinery contributes to the significance of the heritage asset.

7. Supportive Text
Evidence Base for Basements and Policy CE1: Climate Change

2.0 Condensation risk

2.1 Installing insulation to reduce heat loss is a fabric improvement where care must be taken in detailing and sequence of construction, to avoid the potential for interstitial or surface condensation occurrence, which can be harmful to the structure and occupant health in the long term.

2.2 For internal wall insulation, Condensation Risk Analysis (to BR497 and BS EN ISO 15026 standard) should be undertaken to determine the risk of interstitial or surface condensation prior to the installation of insulation to existing walls.

2.3 The exposure of the wall and its geographical location are to be taken into account, along with the components, sequence of construction and buildings use.
Note this analysis for individual elements in accordance with BS 5250: 2006 and BS EN ISO 13788: 2002 is available from insulation manufacturers but that this has its limitations; the Glaser method on its own is inappropriate as it has limitations for buildings with high thermal mass and moisture capacity as detailed in BS EN ISO 13788:2012.

2.4 This could be subject to a planning condition, to be discharged upon submission of a Condensation Risk Analysis report.

3.0 Breathability of solid wall brick construction

3.1 Existing solid wall construction is often 'breathable' (i.e. the wall is vapour permeable, hygroscopic and capillary active) and care must be taken to avoid trapping moisture within the existing wall by inappropriate internal construction.

3.2 The external material and its potential for water absorption and retention and the exposure of the existing construction must be taken into account when designing and detailing fabric improvements.

3.2 Wind driven rain has a significant impact and the exposure and orientation of the existing construction must be taken into account. In exposed positions where internal fabric improvements are proposed, the potential for reducing the wind driven rain by external alterations should be considered - again with reference to the significance of the heritage asset and with measures proportional to this significance.

7. Supportive Text
Evidence Base for Basements and Policy CE1: Climate Change

4.0 Ventilation

4.1 Improving the air tightness of existing buildings can have a significant impact on improving their thermal performance. Reducing cold draughts through sash windows, doors, chimneys and letter boxes can all contribute to heat loss.

4.2 Background ventilation to dwellings is a requirement of Building Regulations (Part F) appropriate ventilation is also required for combustion appliances (Part J) and care must be taken to achieve or maintain these requirements.

4.3 Fabric improvements such as internal wall insulation, double glazing and improved air tightness as a result of blocking chimneys can have a significant impact on increasing internal humidity levels and can lead to problematic internal surface condensation occurrence. In order to avoid this, care must be taken to ensure that adequate ventilation has been provided with regard to the use of the room, its existing ventilation and its levels of heat loss. Mechanical ventilation should also be considered, along with the potential benefit of heat recovery.

4.4 The impact of these measures should be assessed in relation to the significance of the heritage asset and addressed by the applicant in the Design & Access and/or Heritage Statements.

5.0 Cold Bridging

5.1 Improvements to the thermal performance of the building fabric must be addressed as a whole. Where insulation to specific elements is being installed or upgraded, care is needed in detailing and construction to avoid or minimize cold bridging so that the overall design performance is optimised and the desired Energy Efficiency Rating is achieved. Where fabric improvements are proposed, cold bridging (and any resulting potential for condensation) has a proportionately higher impact on the overall thermal performance than in the existing building.

5.2 Cold bridging analysis (to BR497 Standard) should be undertaken for proposed fabric improvements to listed buildings to test for surface condensation risk. Areas where interstitial condensation could occur should be modelled to BS EN ISO 15026 standard and mitigation measures should be implemented to mitigate cold bridging and avoid both surface and interstitial condensation.

5.3 For listed building fabric upgrades, this could be made subject to a planning condition, to be discharged upon receipt of the analysis to BR497 and BS EN ISO 15026 Standards, demonstrating compliance.

8. Analysis
Evidence Base for Basements and Policy CE1: Climate Change

Introduction

Three properties within the Borough have been chosen for modeling and analysis of carbon savings. This section seeks to evaluate the specific issues faced by development works taking place within the Borough, and to establish the ways in which a BREEAM 'Very Good' rating can be achieved within a heritage setting.

This section covers the recommendations for minimum standards with regards to waste and carbon production and water use, and how a BREEAM 'Excellent' rating can be achieved in a heritage setting such as Kensington and Chelsea. Please refer also to an example preliminary assessment for a 'Very Good' rating to a listed dwelling, found within the appendices of this document.

<table>
<tr><th></th><th>BREEAM Rating</th><th>Carbon Target</th><th>Waste Target</th><th>Water Target</th></tr>
<tr><td>Residential refurbishment including including new basement</td><td>Very Good</td><td rowspan="2">Minimum standard for Excellent - SAP Rating of 70</td><td rowspan="2">80% of un-weighted waste credits</td><td rowspan="2">Minimum standard for Very Good</td></tr>
<tr><td>Residential refurbishment constituting major development</td><td>Excellent</td></tr>
<tr><td>New residential development with basement</td><td colspan="4">Code for Sustainable Homes Level 4</td></tr>
</table>

8. Analysis

8.1 BREEAM Rating Evidence Base for Basements and Policy CE1: Climate Change

Introduction

As detailed in section 5, the recommendation for basement extensions to dwellings in the Borough is for either a BREEAM Domestic Refurbishment 'Very Good' or 'Excellent' rating, depending on the size of scheme, with minimum requirements in carbon, water and waste. For residential buildings with a basement, the recommendation is for a BREEAM 'Very Good' to be achieved. Where there is residential refurbishment of over 1000 m^2, BREEAM 'Excellent' is the suggested target.

Analysis of case studies

The case studies included in this document demonstrate that achieving a BREEAM Domestic Refurbishment 'Very Good' rating is possible for both Listed and Unlisted buildings. See appendix 3 for a full breakdown of the BREEAM credits.

Minimum requirement for ventilation

It should be noted however that the BREEAM Domestic Refurbishment methodology includes a number of clauses that relate to 'historic' buildings, namely listed buildings and those within conservation areas, which makes the inclusion of an outside consultant and pre-refurbishment testing necessary. In particular, when targeting a BREEAM 'Very Good' rating, a single credit is mandatory under the ventilation issue Hea 05. Where a building is 'historic' this means that pre-refurbishment airtightness and structural moisture testing must be carried out, the results of which must go on to inform the ventilation strategy to ensure surface condensation levels are minimised and indoor air quality levels are optimised.

Other minimum standards

BREEAM issue	Minimum standards for a Very Good
Ene 02: Energy efficiency rating post-refurbishment	2 credits
Wat 01: Internal water use	1 credit
Hea 05: Ventilation	1 credit
Hea 06: Safety	1 credit
Pol 03: Flooding	-
Mat 02: Responsible sourcing of materials	Criterion 3 only

Off-set Scheme

The analysis as part of Appendix 3, indicates that it is possible to meet the BREEAM Very Good rating on a Listed Building as defined by the Heritage Checklist in Appendix 1. Therefore, the recommendation is for Listed Buildings to meet the Very Good standard without an offset scheme.

8. Analysis

8.1 BREEAM Rating Evidence Base for Basements and Policy CE1: Climate Change

Residential Refurbishment Constituting Major Development

As detailed in section 5, for residential refurbishment of over 1000 m^2, the recommendation is that a BREEAM 'Excellent' rating is achieved. In this case, the rating benchmark is 70% (a safety margin of 5% over this figure is recommended), which is 15% higher than the requirement for a 'Very Good' rating. Minimum standards exist for the issues detailed in the table below:

The additional credits for Ene 02 and Wat 01 can be achieved by implementation of a number of fabric upgrades and water attenuation measures. As a large portion of the RBKC is located outside of the flooding 'Zone 1', the Pol 03 credits can be achieved through the production of an extensive flood risk assessment by a suitably qualified hydrologist, detailing the flood defences to the River Thames.

Excellent rating minimum standards

BREEAM issue	Minimum standards for an Excellent
Ene 02: Energy efficiency rating post-refurbishment	2.5 credits
Wat 01: Internal water use	2 credits
Hea 05: Ventilation	1 credit
Hea 06: Safety	1 credit
Pol 03: Flooding	2 credits
Mat 02: Responsible sourcing of materials	Criterion 3 only

8. Analysis

8.2 Carbon Target Evidence Base for Basements and Policy CE1: Climate Change

Introduction

The carbon target has been tested with various case studies to check that the suggested policy can be met with appropriate measures in proportion to both the heritage significance of the building and the extent of the works.

In particular, **an objective is to ensure that the policy does not require whole house refurbishments to include internal wall insulation**. Therefore, the policy has been tested to ensure that the suggested target can be met either by upgrading the services and roof insulation or through a 'fabric first' approach.

A full breakdown of the analysis of each case study is provided in appendix 3 including the modeling inputs for the SAP 2009 analysis.

Unlisted

For Unlisted buildings, a whole house refurbishment, including upgrades to the windows, walls, floor and roof as well as boiler replacement, at 80% efficiency is tested.

Listed

For listed buildings, an upgrade based on improving the services and roof insulation only is tested.

Policy Implications

The table shows that in all case studies, the suggested policy can be met. In addition, the policy allows either a Listed or Unlisted building to meet the policy.

Case Study	Option	SAP Rating	Policy Target Carbon Target
1	Unlisted	75	Post Refurbishment SAP Rating of 70, or minimum standard for Excellent
2	Listed	71	
3	Unlisted	82	
4	Listed	74	
5	Unlisted / Listed	71	

Whole House Refurbishment

The policy recommendation can be met through upgrading the building services and roof insulation only.

8. Analysis

8.3 Waste Target Evidence Base for Basements and Policy CE1: Climate Change

Introduction

Refurbishment works including basement extensions produce a significant volume of demolition (including excavation) and construction waste. The Policy aim is to require developers to minimise and then divert waste from landfill by reducing and recycling waste materials. The policy does not set minimum waste targets for household recycling.

The policy recommendation is for 4 of 5 of the waste credits to be achieved as detailed in the below table.

Excellent rating minimum standards

BREEAM issue	Implications
Was 01: Household Waste	First credit : Provide appropriate internal kitchen recycling bin.
	Second credit : Provide a composting facility in an external area.
Was 02: Refurbishment Site Waste Management	First credit: Undertake a Site Waste Management Plan to monitor construction waste.
	Second credit: Maximum Volume of Construction Waste.
	Third credit: Minimum Rates of Diversion from Landfill.

Policy Implications

The policy requires contractors to develop a pre-refurbishment/pre-demolition audit to determine how to maximise the recovery of material from the refurbishment. The lead contractor will be required to ensure that a compliant Site Waste Management Plan, which will include procedures and commitments to reduce non-hazardous demolition and construction waste, to be developed and updated regularly during the construction phase to demonstrate that the reduction of waste generation will be or is being met.

The plan will show how the second and third Was 02 credits can be achieved. The second credit relates to the maximum volume of construction waste, which does not include demolitions or excavations. The third credit is for the volume or tonnes targets for construction waste and demolition waste to be diverted from landfill, as per the table below.

Waste Type	Volume	Tonnes
Non-Hazardous Construction waste	70%	65%
Non-Hazardous Demolition waste	80%	90%
Amount of non-hazardous construction waste generated per £100,000 of project value	26.52 m^3	16.90

On typical sites within the Borough, it will be waste sub-contractors that collect unsegregated waste from the construction works. The policy would require the developer to set a target for waste sub-contractors to recycle a percentage of waste in line with the table above and report back to the BREEAM assessor.

9. Conclusion
Evidence Base for Basements and Policy CE1: Climate Change

Recommendation

The aim of the evidence base is to recommend an appropriate revision to RBK&C's Basement Sustainability Policy and Policy CE1. The policy objective is for the additional embodied carbon emissions as a result of basements to be offset through whole house environmental measures appropriate to the historic environment. It is the recommendation of this report to use BREEAM Domestic Refurbishment (BDR) as the policy tool to implement the legislation. The report sets out the suitable standard based on an analysis of case studies of various building types. Due regard has been paid to ensure that only measures permissible in both listed buildings and unlisted buildings within a Conservation Area have been analysed as environmental upgrades, in line with the Heritage Checklist, (see appendix 2).

The analysis has demonstrated that a Very Good standard is appropriate for listed and unlisted buildings within a Conservation Area. As a carbon target to make carbon savings proportional to the embodied carbon impact of basements, the recommended policy target is to set the minimum standard of Excellent in the Energy section as the policy tool. Furthermore, BDR's minimum standards exclude waste, therefore, it is the recommendation of this report to require the buildings covered by the policy achieve 80% of the percentage points available under the waste section.

For Listed buildings, the policy requirement of Very Good under BDR has been tested using case studies and measures derived from the Heritage Checklist. It is important to note that the checklist stipulates that all Listed buildings are to be treated on a case by case basis.

The policy recommendation for new residential development with basement to achieve a Code for Sustainable Homes Level 4 rating.

<table>
<tr><th></th><th>BREEAM Rating</th><th>Carbon Target</th><th>Waste Target</th><th>Water Target</th></tr>
<tr><td>Residential refurbishment including new basement</td><td>Very Good</td><td rowspan="2">Minimum standard for Excellent - SAP Rating of 70</td><td rowspan="2">80% of un-weighted credits in the waste category</td><td rowspan="2">Minimum standard for Very Good</td></tr>
<tr><td>Residential refurbishment constituting major development</td><td>Excellent</td></tr>
<tr><td>New residential development with basement</td><td colspan="4">Code for Sustainable Homes Level 4</td></tr>
</table>

Appendix 1
Heritage Checklist Evidence Base for Basements and Policy CE1: Climate Change

Notwithstanding the below checklist each listed building will need to be assessed on its individual merits as what may be acceptable for one building may not be acceptable for another. Advice should always be sought form the Local Authority's Conservation and Design Section prior to undertaking any works to ascertain the acceptability of each measure and to determine which consents are required.

		Design and Conservation Implications		
Building Element	Description of Measure	Listed Buildings	Conservation Area	Non Conservation Area
Wall Insulation	50mm insulation and lining to the front (internal)	High	Low	Low
Wall Insulation	50mm insulation and lining to the rear (internal)	High	Low	Low
Wall Insulation	50mm insulation and render to the front (external)	High	High	Low
Wall Insulation	50mm insulation and render to the rear (external)	High	High	Low
Roof Insulation	200mm of mineral fibre insulation in roof space	Low	Low	Low
Floor Insulation	100mm insulation in suspended timber flooring	Low	Low	Low
Window Type A	Replacement 14mm glazing within existing frame and sash boxes	High	Low	Low
Window Type B	Replace window frames as existing and use 24mm double glazing	High	Low	Low
Window Type C	Replace with high performance casement windows	High	High	Low
Doors	Replace entrance door with insulated door	High	Low (1)	Low
Windows	Replace rooflights with high performance glazing	High	Low	Low
Boiler	Install efficient system boiler	Low	Low	Low
Other	Infill and cap existing chimneys	High	Low (2)	Low
Air Tightness	Carry out air tightness improvements on building fabric to achieve air permeability of 10 or less	Low	Low	Low
Ventilation	Install Mechanical Ventilation with Heat Recovery	Low	Low	Low
Renewables	Install Solar Hot Water panel to the front	High	High	Low
Renewables	Install Solar Hot Water panel to the rear	High	Low	Low
Renewables	Install Photovoltaic panel to the front	High	High	Low
Renewables	Install Photovoltaic panel to the rear	High	Low	Low
Renewables	Install a Ground Source Heat Pump to provide for heating and hot water	Low	Low	Low
Renewables	Install a Wind Turbine	High	High	Low
Cooling	Install Comfort Cooling with plantwork to the front	High	High	Low

(1) Replacement may be acceptable subject to Design and Conservation comments or
(2) Subject to replacement of chimney pots and detailed approval from Design and

Appendix 2
Carbon Analysis
Evidence Base for Basements and Policy CE1: Climate Change

Brief

The following pages provide the modelling inputs for each case study showing the building fabric U-values and services modelled to demonstrate how the carbon policy recommendations can be met for each case study.

The below table provides a summary of the case studies and the policy target for each:

Case Study	Option	SAP Rating	Policy Target Carbon Target
1	Unlisted	75	Post Refurbishment SAP Rating of 70, or minimum standard for Excellent
2	Listed	71	
3	Unlisted	82	
4	Listed	74	
5	Unlisted / Listed	71	

Carbon Analysis
Case Study 1

Unlisted	The building fabric has been upgraded in line with measures for an unlisted building in the Heritage Checklist and the services have been replaced to achieve high efficiency services. The scheme meets the minimum requirements for an Excellent energy standard in line with the policy recommendation.

Building Fabric

Proposed Element	Description	Source	Modelled U-Value (W/m2K)	Part L1B Minimum Requirements (W/m2K)
Basement Floor	Insulated Slab	U-Value Calculator	0.22	0.22
External Walls (existing)	Solid brick walls with internal wall insulation	U-Value Calculator	0.30	0.30
New Basement Walls	Cavity wall with 100mm insulation	U-Value Calculator	0.18	0.28
Roofs	Timber structure with insulation	U-Value Calculator	0.18	0.18
Windows – double glazed	New double glazing panes matching existing frames	Manufacturer input	1.60	1.60
Windows – new double glazed	New double glazed basement windows	Likely worst-case, likely to achieve 1.60	1.60	1.60
Air permeability	Default value used in refurbishment	Likely worst-case, aspirational target 15	15 m^3/hour/m^2 at 50 Pa.	None
Thermal bridging: average Y-value	Default case used	Worst-case defaults used	0.15 W/m^2K or default	None

Ventilation	Natural ventilation will be used throughout the dwelling, with mechanical extract to wet rooms and kitchens.	Mechanical Ventilation with Heat Recovery is specified for the new basement. The SPF is assumed to be 0.55 and the Heat Exchange Efficiency of 90%
Heating	Space heating to be provided by a regular condensing gas boiler with an efficiency of 80%, distributed via radiators and controlled via room thermostat only.	
Cooling	Cooling not provided.	
Hot Water	Direct hot water shall also be provided by the boiler via an insulated hot water cylinder.	
Lighting	100% dedicated energy efficient lighting installed throughout the development.	
EER / SAP rating achieved	75, Band C	

Carbon Analysis
Case Study 2

Listed	The building fabric has been upgraded in line with measures for a listed building in the Heritage Checklist and the services have been replaced to achieve high efficiency services. The scheme meets the minimum requirements for an Excellent energy standard in line with the policy recommendation.

Building Fabric

Proposed Element	Description	Source	Modelled U-Value (W/m2K)	Part L1B Minimum Requirements (W/m2K)
Basement Floor	Insulated Slab	U-Value Calculator	0.22	0.22
External Walls (existing)	Solid brick uninsulated	U-Value Calculator	1.40	0.30
New Basement Walls	Cavity wall with 100mm insulation	U-Value Calculator	0.18	0.28
Roofs	Timber structure with insulation	U-Value Calculator	0.15	0.18
Windows –single glazed	Refurbished to reduce air leakage	SAP Default value	4.8	1.60
Air permeability	Default value used in refurbishment	Likely worst-case, aspirational target 15	15 m^3/hour/m^2 at 50 Pa.	None
Thermal bridging: average Y-value	Default case used	Worst-case defaults used	0.15 W/m^2K or default	None

Ventilation	Natural ventilation will be used throughout the dwelling, with mechanical extract to wet rooms and kitchens.	Mechanical Ventilation with Heat Recovery is specified for the new basement. The SPF is assumed to be 0.55 and the Heat Exchange Efficiency of 90%
Heating	An efficient gas boiler system, with a SEDBUK 2009 efficiency of 85% will provide space heating and domestic hot water. Space heating will be provided by a radiator system, and will be controlled by a programmer, room thermostat and boiler energy manager, an interlock and an enhanced load compensator.	
Cooling	Cooling not provided.	
Hot Water	Direct hot water also provided by the boiler via an insulated hot water cylinder.	
Lighting	100% dedicated energy efficient lighting installed throughout the development.	
EER / SAP rating achieved	71, Band C	

Carbon Analysis
Case Study 3

Unlisted	The building fabric has been upgraded in line with measures for an Unlisted Building in the Heritage Checklist and the services have been replaced to achieve high efficiency services. The scheme meets the minimum requirements for an Excellent energy standard in line with the policy recommendation.

Building Fabric

Proposed Element	Description	Source	Modelled U-Value (W/m2K)	Part L1B Minimum Requirements (W/m2K)
Basement Floor	Insulated Slab	U-Value Calculator	0.22	0.22
External Walls (existing)	Solid brick with internal wall insulation	U-Value Calculator	0.30	0.30
New Basement Walls	Cavity wall with 100mm insulation	U-Value Calculator	0.18	0.28
Roofs	Timber structure with insulation unchanged	U-Value Calculator	0.28	0.28
Windows –single glazed	Existing glazing panes and frames retained	SAP Default value	1.6	0.18
Windows – new double glazed	New double glazed casement windows	Likely worst-case, likely to achieve 1.60	1.60	1.60
Air permeability	Default value used in refurbishment	Likely worst-case, aspirational target 15	15 m^3/hour/m^2 at 50 Pa.	None
Thermal bridging: average Y-value	Default case used	Worst-case defaults used	0.15 W/m^2K or default	None

Ventilation	Natural ventilation will be used throughout the dwelling, with mechanical extract to wet rooms and kitchens.	Mechanical Ventilation with Heat Recovery is specified for the new basement. The SPF is assumed to be 0.55 and the Heat Exchange Efficiency of 90%
Heating	Space heating to be provided by a regular condensing gas boiler with an efficiency of 80%, distributed via radiators and controlled via room thermostat only.	
Cooling	Cooling provided.	
Hot Water	Direct hot water provided by the boiler via an insulated hot water cylinder.	
Lighting	100% dedicated energy efficient lighting installed throughout the development.	
EER / SAP rating achieved	82, Band B	

Carbon Analysis
Case Study 4

Listed	The building fabric has been upgraded in line with measures for a Listed Building in the Heritage Checklist and the services have been replaced to achieve high efficiency services. The scheme meets the minimum requirements for an Outstanding energy standard in line with the policy recommendation.
Building Fabric	:

Proposed Element	Description	Source	Modelled U-Value (W/m^2K)	Part L1B Minimum Requirements (W/m^2K)
Basement Floor	Insulated Slab	U-Value Calculator	0.20	0.22
External Walls (existing)	Solid brick uninsulated	U-Value Calculator	1.40	0.30
New Basement Walls	Cavity wall with 100mm insulation	U-Value Calculator	0.18	0.28
Roofs	Timber structure with insulation unchanged	U-Value Calculator	0.15	0.18
Windows – single glazed	Existing glazing panes and frames retained	SAP Default value	4.8	1.60
Air permeability	Default value used in refurbishment	Likely worst-case, aspirational target 15	15 m^3/hour/m^2 at 50 Pa.	None
Thermal bridging: average Y-value	Default case used	Worst-case defaults used	0.15 W/m^2K or default	None

Ventilation	Natural ventilation will be used throughout the dwelling, with mechanical extract to wet rooms and kitchens.	Mechanical Ventilation with Heat Recovery is specified for the new basement. The SPF is assumed to be 0.55 and the Heat Exchange Efficiency of 90%
Heating	An efficient gas boiler system, with a SEDBUK 2009 efficiency of 85% will provide space heating and domestic hot water. Space heating will be provided by a radiator system, and will be controlled by a programmer, room thermostat and boiler energy manager, an interlock and an enhanced load compensator.	
Cooling	Cooling will be provided.	
Hot Water	The hot water store will have a maximum capacity of 500 litres, and will be insulated with spray foam with a thickness of 20 mm.	
Lighting	100% dedicated energy efficient lighting installed throughout the development.	
EER/ SAP rating achieved	74, Band C	

Carbon Analysis
Case Study 5

Unlisted / Listed	The building fabric has been upgraded in line with measures for an Unlisted Building in the Heritage Checklist and the services have been replaced to achieve high efficiency services. The scheme meets the minimum requirements for an Outstanding energy standard in line with the policy recommendation.
Building Fabric	Targeted U-Values are:

Proposed Element	Description	Source	Modelled U-Value (W/m^2K)	Part L1B Minimum Requirements (W/m^2K)
Ground / Basement Floor	Default case	U-Value Calculator	0.22	0.22
External Walls (existing)	Solid brick walls	U-Value Calculator	1.4	n/a
New Basement Walls	Cavity wall with 100mm insulation	U-Value Calculator	0.18	0.28
Roofs	Timber structure with insulation	U-Value Calculator	0.15	0.18
Windows – single glazed	Refurbished to reduce air leakage	SAP default value	4.8	1.60
Air permeability	Default value used in refurbishment	SAP default value	15 m^3/hour/m^2 at 50 Pa.	None
Thermal bridging: average Y-value	Default case used	SAP default value	0.15 W/m^2K or default	None

Ventilation	Natural ventilation will be used throughout the dwelling, with mechanical extract to wet rooms and kitchens.	Mechanical Ventilation with Heat Recovery is specified for the new basement. The SPF is assumed to be 0.55 and the Heat Exchange Efficiency of 90%
Heating	An efficient condensing gas boiler system, with a SEDBUK 2009 efficiency of 85% will provide space heating and domestic hot water. Space heating will be provided by a radiator system, and will be controlled by time and temperature zone control, an interlock and an enhanced load compensator. The boiler will be fitted with a flue gas heat recovery system.	
Cooling	Cooling not provided.	
Hot Water	Direct hot water provided by the main boiler via an insulated hot water cylinder.	
Lighting	100% dedicated energy efficient lighting installed throughout the development.	
EER / SAP rating achieved	71, Band C	

Appendix 3
BREEAM Analysis Evidence Base for Basements and Policy CE1: Climate Change

Introduction	The following pages provide the indicative credits for meeting a BREEAM Very Good rating for a Listed Building in a Conservation Area.
Score Summary	The site reviewed currently scores a VERY GOOD rating, at 57.36%. The VERY GOOD rating required by policy recommendation calls for a score of at least 55% at formal assessment.
Fictive Building Summary	The proposed development comprises extensive refurbishment work to a mid terrace, Georgian townhouse, including a lower-ground floor extension beneath the garden to the rear of the property. The dwelling is located in a conservation area and is listed Grade II. The building dates from the late 18th Century; features of note include oriel windows that incorporate the original cast glass panes.

Rating Summary

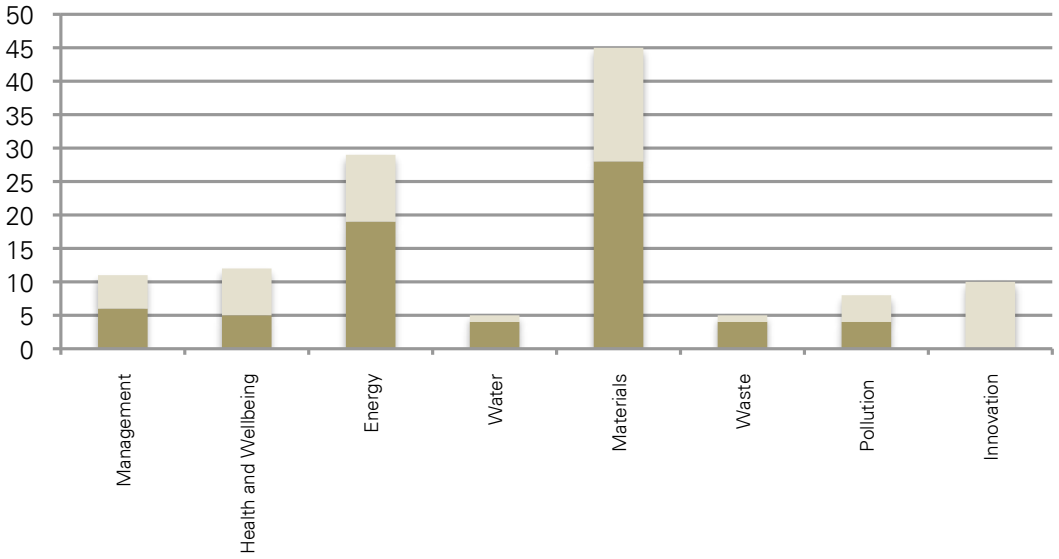
Case Study 1 BREEAM Domestic Refurbishment

Summarised Score

	Credits available	No. Achieved	% Achieved	Weighting Factor	Credits Score
Management	11	6	55	0.12	6.55
Health and Wellbeing	12	4	33	0.17	5.67
Energy	29	19	66	0.43	28.17
Water	5	3	60	0.11	6.60
Materials	45	28	62	0.08	4.98
Waste	5	4	80	0.03	2.40
Pollution	8	4	50	0.06	3.00
Innovation	10	0	0	0.10	0.00
Total					**57.36%**
Rating					VERY GOOD

Graphic Breakdown

The graph below shows the credits targeted in the proposed scheme (dark green) and the potential credits that are achievable (light green) under BREEAM Domestic Refurbishment. Please see the remaining portions of the report for details of credits that have been achieved.



Preliminary Assessment
Case Study 1
BREEAM Domestic Refurbishment

INTRODUCTION	The following pages show how the specification for Case Study 1 would perform against the BREEAM Domestic Refurbishment criteria where cost and the involvement of outside consultants were being kept to a minimum.	
MANAGEMENT		
Man 01 – Home Users Guide	For these credits a Home Users Guide would be provided, informing future occupiers on the correct operation of the building's various systems. Three of the available three credits would be targeted in this scenario.	3 of 3
Man 02 – Responsible Construction	The site would be registered with the Considerate Constructors Scheme; a score of between 25 and 34 would need to be achieved with at least 5 points in each of the 5 sections. One of the available two credits would be targeted in this scenario. Where two credits were targeted and obtained, an additional credit would be available under the Innovation issue Inn 01 for exemplary performance.	1 of 2
Man 03 – Construction Site Impacts	To gain a credit for this issue, the refurbishment would need to be managed in an environmentally sound manner through the monitoring of energy and water consumption, and the undertaking of measures to prevent pollution. The available credit for this issue would be targeted in this scenario.	1 of 1
Man 04 - Security	Security credits can be difficult to achieve in a heritage setting where historic doors and windows are being retained; they would not be targeted in this scenario. Of the two available credits, none would be targeted in this scenario.	0 of 2
Man 05 – Ecological Features	Ecology credits can be difficult to achieve in a dense urban setting where outdoor space is minimal and few features of ecological value exist; they would not be targeted in this scenario. The available credit would not be targeted in this scenario.	0 of 1

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Man 06 – Project Management	To gain a credit for this issue, all members of the project team would need to be involved in project decision-making, and the individual/shared roles and responsibilities of each member assigned across the key design and refurbishment stages. One of two credits would be targeted in this scenario. Where both credits were targeted and achieved, two additional credits would be available under the Innovation issue Inn 01 for exemplary performance.	1 of 2

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Case Study 1
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HEALTH AND WELLBEING		
Hea 01 - Daylighting	To gain a credit under this issue, the refurbishment works would need to have a neutral impact on the dwelling's daylighting levels in the kitchen, living room, dining room and study (see issue Ene 10: Home Office). One of the available two credits would be targeted in this scenario.	1 of 2
Hea 02 – Sound Insulation	To gain a credit for sound insulation, testing of the impact and airborne sound insulation values could be carried out both pre- and post-development, to ensure a neutral impact on the building's existing sound insulation properties. Given that this would involve an additional consultant, the credit is not targeted. None of the available four credits would be targeted in this scenario.	0 of 4
Hea 03 – Volatile Organic Compounds	For this credit, internal finishes and fittings that emit high levels of volatile organic compounds would be avoided in the development specification. The available credit for this issue would be targeted in this scenario.	1 of 1
Hea 04 – Inclusive Design	Inclusive design credits are often difficult to achieve due to historic features of the building such as stairs to the principal access point of the building. Of the two available credits, none would be targeted in this scenario. Where both credits were targeted and obtained, an additional credit would be available for exemplary performance under issue Inn 01.	0 of 2
Hea 05 – Ventilation	NB: MINIMUM STANDARD FOR BREEAM 'VERY GOOD': 1 CREDIT For this credit, ventilation standards would need to be met in line with the BRE requirements for historic buildings. This involves air leakage and structural moisture testing, the results of which would then inform the ventilation strategy. One of the two available credits would be targeted in this scenario, and would have to be obtained in order to achieve a BREEAM 'Very Good' rating.	1 of 2

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Hea 06 – Safety

MINIMUM STANDARD FOR BREEAM 'VERY GOOD': 1 CREDIT

A mandatory credit for all BREEAM ratings, fire and carbon monoxide detection systems would be installed, meeting the following requirements:

- The fire detection system would need to be a Grade D, Category LD3 system in accordance with BS 5839-6: 2004, positioned in accordance with Approved Document B.
- Carbon Monoxide detection systems would need to meet BS EN 50291-1:2001 (40), positioned in accordance with BS EN 50292:2002.

The available credit for this issue would be targeted in this scenario, and would have to be obtained in order to achieve a BREEAM 'Very Good' rating.

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ENERGY		
Ene 01 – Improvement in EER	To gain credits under this issue, the energy efficiency of the dwelling would need to be improved, thus reducing its associated CO_2 emissions. The current credits are based on the measures possible for a Listed building as provided in the Heritage Checklist, see appendix 2. To evaluate the level of improvement, the BREEAM Domestic Refurbishment Energy Calculator would be used to calculate the Energy Efficiency Rating for before and after refurbishment, with information obtained from full SAP 2009 energy modelling. Two and a half of the available six credits would be targeted in this scenario.	2.5 of 6
Ene 02 – EER Post Refurbishment	MINIMUM STANDARD: BREEAM 'VERY GOOD': 2 CREDITS A follow-on from the previous issue, the dwelling's post-refurbishment Energy Efficiency Rating (equivalent to its SAP rating) would equate to a BREEAM benchmark, and credits awarded according to its 'as-built' rating. The current credits is based on the measures possible for a Listed building as provided in the Heritage Checklist, see appendix 2. Two and a half of the available four credits would be targeted in this scenario, two of which would have to be achieved as a minimum requirement for a BREEAM 'Very Good' rating. Where all credits were achieved, two innovation credits are also available for exemplary performance under issue Inn 01.	2.5 of 4
Ene 03 – Primary Energy Demand	To gain credits for this issue, efforts would have to be made to reduce the absolute total regulated energy demand of the dwelling, as a result of refurbishment. This would be calculated using full SAP 2009, the resulting figure would then be compared against a BREEAM benchmark and credits awarded accordingly. The current credits is based on the measures possible for a Listed building as provided in the Heritage Checklist, see appendix 2. Six of the available seven credits would be targeted in this scenario.	6 of 7

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Ene 04 – Renewable Technologies	Given the heterogeneity of sites in the Borough, the credit for applying low and zero carbon technologies is not targeted as some sites may be able to implement technologies where others may not. Therefore, credits for on-site renewable energy generation would not be targeted in this scenario. Credits for this issue would not be targeted in this scenario.	0 of 2
Ene 05 – Energy Labelled White Goods	Credits for specifying and purchasing white goods that are recognised by the Energy Saving Trust or the EU Energy Efficiency Labelling Scheme are easily achievable. For full credits, the following ratings would comply with the BRE requirements: • Fridges, freezers, fridge-freezers, washing machines and dishwashers carrying the Energy Saving Trust 'Recommended' Label. • Washer dryers and tumble dryers rated 'B' under the EU Energy Efficiency Labelling Scheme. Where any of the above appliances are not supplied, the EU Energy Efficiency Labelling Scheme Information Leaflet could be provided in lieu, as part of the Home Users Guide. Two of the available two credits would be targeted in this scenario. Please see issue Wat 01 for additional requirements regarding the water consumption of washing machines and dishwashers.	2 of 2
Ene 06 – Drying Space	For the drying space credit, 4m+ of clothes-drying line would be provided to the dwelling, fixed within an external space or an adequate, secure internal space, ventilated in accordance with Part F of the building regulations. Where the dwelling had only 1 or 2 bedrooms, the length of drying line could be reduced to 4m. The available credit for this issue would be targeted in this scenario.	1 of 1
Ene 07 - Lighting	For lighting credits, energy efficient lighting would be specified throughout the dwelling. The internal lighting system would need to have an energy demand of no more than 9 watts/m^2 of the total floor area, and external lighting would meet the BRE's requirements for Energy Efficient Space Lighting. Two of the available two credits would be targeted in this scenario.	2 of 2

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Ene 08 – Energy Display Devices	To gain the energy display devices credit, a visual display device would be specified, fixed in a location within the dwelling that would be visible to occupants, and the following information displayed: 1. Current electricity consumption 2. Current primary heating fuel consumption 3. Current emissions (kg of CO_2) 4. Current cost (£ per hour) 5. Projected cost (£ per month and £ per year) Of the available two credits, two would be targeted in this scenario.	2 of 2
Ene 09 – Cycle Storage	Due to the potential lack of sufficient space for a secure storage facility, credits would not be targeted for cycle storage in this scenario. Of the available two credits, none would be targeted in this scenario.	0 of 2
Ene 10 – Home Office	The Home Office credit is easily obtained where electrical re-wiring forms part of the refurbishment strategy. In this scenario, the space and services necessary for occupants to be able to work from home would be provided and the BRE's criteria for space and ventilation would be met. The room would incorporate the following services: • Two double power sockets • One telephone point • A window with an openable casement of no less than 0.5$m^{2,}$ and whose width or height is no less than 450mm. The available credit would be targeted in this scenario.	1 of 1

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WATER

Wat 01 – Internal Potable Water Use

MINIMUM STANDARD: BREEAM 'VERY GOOD': 1 CREDIT 1 of 3

A minimum standard under this scheme, internal water use attenuation measures would be implemented. Although a number of options are available to achieve two credits for this issue, Eight Associates would recommend the following specification for bathrooms only:

- Taps with a flow rate of five litres per minute or less
- Showers with a flow rate of 8 litres per minute or less
- Baths with a capacity of no more than 140 litres to overflow
- WCs with an effective flushing volume of 4 litres
- Dishwashers with a consumption of no more than 1 litre per place setting
- Washing machines with a consumption of no more than 6.47 litres per kg.

The calculated water consumption would need to meet the target of <118 litres per person resident in the dwelling, per day.

Two of the available three credits would be targeted in this scenario, which would meet the minimum requirements for a BREEAM 'Very Good' rating.

Wat 02 – External Water Use

To obtain the external water use credit, a water butt would be installed within the private space to the rear of the property for irrigation purposes, in line with BRE requirements. 1 of 1

The available credit for this issue would be targeted in this scenario.

Wat 03 – Water Meter

To obtain the water meter credit, an appropriate water meter would be installed in a location within the dwelling, visible to occupants to provide a visible display of mains potable water consumption. It would be capable of recording and displaying historic water consumption to allow this to be monitored over time. 1 of 1

The available credit would be targeted in this scenario.

Preliminary Assessment
Case Study 1
BREEAM Domestic Refurbishment

MATERIALS		
Mat 01 – Environmental Impact of Materials	In this scenario, it would be expected that many of the building's existing elements would be retained and their performance enhanced. Where new materials were required, those with the optimal balance of low environmental impact and high thermal performance would need to be specified. Sixteen of the twenty-five available credits would be targeted in this scenario.	16 of 25
Mat 02 – Responsible Sourcing of Materials	MINIMUM STANDARD: BREEAM 'VERY GOOD': CRITERION 3 ONLY To obtain credits for this issue, efforts would be made to reuse materials where feasible, and where required, new materials would be responsibly sourced. Minimum standards apply to new timber, which must be sourced in accordance with the UK Government's Timber Procurement Policy - a minimum requirement for this issue. Four credits would be obtainable where $\geq$18% of the points were achieved for the tier levels set out by the BRE. Four of the available twelve credits would be targeted in this scenario.	4 of 12
Mat 03 - Insulation	To obtain the insulation credits, where thermal insulation is required, responsibly sourced materials with a low embodied environmental impact relative to its thermal properties would be specified in line with BRE requirements. Eight of the available eight credits would be targeted in this scenario.	8 of 8

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Case Study 1
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WASTE		
Was 01 – Household Waste	To gain a credit for this issue, household recycling facilities would be provided to the dwelling alongside those for non-recyclable waste, thus diverting household waste from landfill or incineration. The RBKC operate a recycling service where waste is collected in orange-coloured refuse sacks and sorted post-collection, thus a single recycling container with a capacity of no less than 30 litres, installed in a fixed location in each dwelling will be sufficient to gain one credit for this issue. One of the available two credits would be targeted in this scenario.	1 of 2
Was 02 – Refurbishment Site Waste	To gain credits for this issue, a Site Waste Management Plan would be implemented by the contractor and the BRE's best practice waste benchmarks met for three credits to be achieved. Three of the available three credits would be targeted for this issue. Where all three credits were obtained, an additional credit would also be available for exemplary performance under issue Inn 01.	3 of 3

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Case Study 1
BREEAM Domestic Refurbishment

POLLUTION		
Pol 01 – NO_X Emissions	To obtain credits for NO_X emissions, efforts would be made to reduce the emission of nitrogen oxides into the atmosphere arising from the operation of space heating and hot water systems. Where these emissions were equal to or lower than 70mg/kWh by way of an NO_X Class 5 boiler, two credits would be achievable. Two of the three available credits would be targeted in this scenario.	2 of 3
Pol 02 – Surface Water Runoff	Due to the complex nature of achieving these in a dense urban setting where an existing dwelling is being extended, credits for surface water runoff would not be targeted in this scenario. Of the three credits available for this issue, none would be targeted in this scenario. Where all three credits were targeted and obtained, an additional credit would also be available for exemplary performance under issue Inn 01.	0 of 3
Pol 03 - Flooding	A Sustainable Urban Drainage Assessment would be carried out, including a Flood Risk Assessment to determine the development's annual probability of flooding in line with BRE requirements. Two of the available two credits would be targeted in this scenario.	2 of 2

Score Sheet

BREEAM Domestic Refurbishment

Score Summary

			Score	Credits available	Score assessment: Sub-total	Credits available	% achieved	Weighting factor	Credits Score
Management	Man 01	Home Users Guide	3	3	6	11	55	0.1	6.55
	Man 02	Responsible Construction Practices	1	2					
	Man 03	Construction Site Impacts	1	1					
	Man 04	Security	0	2					
	Man 05	Ecological Features	0	1					
	Man 06	Project Management	1	2					
Health and Wellbeing	Hea 01	Daylighting	1	2	4	12	33	0.2	5.67
	Hea 02	Sound Insulation	0	4					
	Hea 03	Volatile Organic Compounds	1	1					
	Hea 04	Inclusive Design	0	2					
	Hea 05	Ventilation	1	2					
	Hea 06	Safety	1	1					
Energy	Ene 01	Improvement in EER	2.5	6	19	29	66	0.4	28.17
	Ene 02	EER Post Refurbishment	2.5	4					
	Ene 03	Primary Energy Demand	6	7					
	Ene 04	Renewable Technologies	0	2					
	Ene 05	Energy Labelled White Goods	2	2					
	Ene 06	Drying Space	1	1					
	Ene 07	Lighting	2	2					
	Ene 08	Energy Display Devices	2	2					
	Ene 09	Cycle Storage	0	2					
	Ene 10	Home Office	1	1					
Water	Wat 01	Internal Water Use	1	3	3	5	60	0.1	6.60
	Wat 02	External Water Use	1	1					
	Wat 03	Water Meter	1	1					
Materials	Mat 01	Environmental Impact of Materials	16	25	28	45	62	0.1	4.98
		Roof	5	5					
		External Walls	5	5					
		Internal / Separating Walls	5	5					
		Upper and Ground Floor	1	5					
		Windows	0	5					
	Mat 02	Responsible Sourcing of Materials	4	12					
	Mat 03	Insulation	8	8					
Waste	Was 01	Household Waste	1	2	4	5	80	0	2.40
	Was 02	Refurbishment Site Waste	3	3					
Pollution	Pol 01	NO_x Emissions	2	3	4	8	50	0.1	3.00
	Pol 02	Surface Water Runoff	0	3					
	Pol 03	Flooding	2	2					
Innovation	Inn 01	Exemplary Performance	0	10	0	10	0	0.1	0.00
						Score:			57.36
						Rating:			Very Good