



Wallace Whittle

**Choose certainty.
Add value.**

The Arc, Reading

Energy Strategy

September 2017

Issue / Revision Record

Issue	Date	By	Checked	Comment
1	05.09.17	AA	MBr	Issue for Comment
2	18.09.17	AA	MBr	Issue for Planning

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We aim to be the pre-eminent provider of quality building services solutions and the best to work with, in the view of our clients, partners and colleagues. We believe in a sustainability led approach to design for the benefit of our clients and the world we live in.

It is our ultimate goal to work closely with our fellow professionals and clients to minimise carbon emissions and to deliver a better environment for us all to live in.

Executive Summary

This report has been developed to outline the Energy Strategy for the proposed development known as The Arc, Reading. This report relates to the energy efficiency proposals and BREEAM performance and will be submitted as part of an outline Planning Application for the scheme.

This Energy Strategy report responds to the requirements of Planning Policy CS1 part of the core strategy which states all new developments should have regard to maximising opportunities for energy efficiency, water efficiency and natural drainage. Further, this report responds to energy efficiency requirements and the associated energy credits laid out in the BREEAM pre-assessment.

The Energy Strategy is assessed using thermal modelling software IES ApacheSIM used for Part L2A of the Building Regulations compliance. This is an approved Government software tool recognised as a benchmarking tool for sustainable design and 'best practice'.

The design incorporates a high performance curtain walling system with solar control glass, low u-values for the roof and floor and high efficiency heating and cooling plant. The lighting will be controlled so that it does not compete with daylight.

Based on the methodology above the predicted carbon dioxide reduction for the proposed development is shown below. The development shall be targeting BREEAM 'Excellent' and we will show a route to achieving this with the appended BREEAM pre-assessment.

The table below summarises the energy performance of The Arc, Reading:

Target Emission Rate Part L 2013 TER (kgCO ₂ /m ²)	Building Emission Rate Part L 2013 BER (kgCO ₂ /m ²)	% reduction
21.3 kgCO ₂ /m ²	17.3 kgCO ₂ /m ²	18.7%

Table 1: CO₂ Reduction

The energy consumption associated with the scheme was assessed in accordance with the Building Regulations Part L2A 2013: Conservation of Fuel and Power (England and Wales) using the National Calculation Method for Dynamic Simulation Modelling. The table shows that the proposed development achieves reductions over the latest version of Part L design, therefore maximising opportunities for energy efficiency.

Contents

	Page
1.0 Introduction	4
2.0 Legislative Compliance	5
3.0 Methodology	6
4.0 Design Criteria	7
5.0 Planning Policy Compliance	11

Appendices

A	Part L2A BRUKL Report
B	BREEAM Pre-Assessment

1.0 Introduction

1.1 General

The Arc is an office development with the intention of creating another landmark building for Reading that will enhance the town's commercial offering as well as improving the quality of the immediate public realm. Additionally, the integration of a publicly-accessible sky garden at the very top of the building will provide a new tourist attraction, with views stretching across the town and beyond within a unique green setting.

1.2 Sources of Information

In the collation of this analysis and report the following sources of information were used:

- Scott Brownrigg Drawings 16367 (10) 001-020
- Scott Brownrigg Drawings 16367 (00) 002
- Scott Brownrigg Drawings 16367 (11) 101-103
- Scott Brownrigg Drawings 16367 (12) 102
- 150831_THE ARC READING_DAS_FIRST_ISSUE

1.3 Objective

The objective of the analysis and this report is to demonstrate that the design complies with the Reading Borough Local Development Framework and Part L2A 2013 of the Building Regulations.

1.4 Limitations

This report has been prepared based on planning drawings. Whilst the information used is taken from the planning drawings the final performance will be dependent on the final commissioning results and actual operation of the building. The Notional and Actual Building calculations use standard NCM operational parameters as required by the NCM rules. These do not match the intended 'Real' building usage exactly but allow a 'like for like' analysis under the Building Regulations. The results presented in this report are therefore not valid for 'Real' building operation.

2.0 Legislative Compliance

2.1 Planning Policy and Building Regulation Targets

The proposed development has been designed to meet sustainability and CO₂ targets outlined within:

- Building Regulations - Part L2A 2013
- Reading Borough Core Strategy (Adopted Jan 2008)
- Reading Borough Revised Sustainable Design and Construction SPD (Adopted July 2011)

2.2 Building Regulations Part L2A 2013 Summary

Part L2A of the Building Regulations 2013 applies to the conservation of fuel and power of all new buildings other than dwellings and is supported by the 'Non-domestic Building Services Compliance Guide'. The development has been assessed against the following criteria:

- Criterion 1: the calculated CO₂ emission rate for the building (the Building CO₂ Emission Rate, BER) must not be greater than the Target CO₂ Emission Rate (TER).
- Criterion 2: the fabric performance and fixed building services of the building achieve reasonable overall standards of energy efficiency.
- Criterion 3: demonstrates that the building has appropriate passive control measures to limit solar gains.
- Criterion 4: the performance of the building, as built, should be consistent with the BER.
- Criterion 5: provisions for enabling energy-efficient operation of the building should be put in place.

2.3 Reading Borough Core Strategy 2008- Policy CS1

All new development proposals should aspire to achieve:

- BREEAM 'Very Good' as a minimum (50% of floor area to 'Excellent')
- Energy efficiency relating to location, design and layout;
- Efficient use of water; and
- Developments incorporate sustainable urban drainage as appropriate
- A 20% carbon reduction from an onsite renewable energy

Please note section 2.4 below as it explains why the 20% carbon reduction is not required.

2.4 Reading Borough Revised Sustainable Design and Construction SPD 2011

The SPD provides further guidance on showing compliance with policy CS1, here it is stated that the 20% carbon reduction requirement is no longer relevant due to it being superseded by the Building Regulations. Furthermore, it states that the overall sustainability of the development must be considered as per appendix 5 from the SPD. Appendix B of this energy strategy shows how these different topics have been addressed.

3.0 Methodology

3.1 Dynamic Simulation Modelling (DSM)

Dynamic thermal simulation is a sophisticated form of building energy modelling. IES Version 2017 DSM software has been used, which is approved National Calculation Method (NCM) simulation software.

It is able to base its performance calculations upon incremental time steps as low as 30 minutes. This allows realistic variations in fabric thermal storage (thermal mass effects), weather conditions, occupancy, internal and solar gains to be taken into account and their implications upon building/plant operation to be modelled effectively.

Dynamic thermal simulation uses zone specific operational profiles (occupancy, lighting, ventilation and DHW demand) and HVAC plant performance data to effectively model and predict the energy performance of a building. The simulation further calculates energy use in connection with non – regulated uses such as appliances.

This comprehensive approach is considered best practice for assessing building energy consumption.

3.2 Weather Data

To accurately model the dynamic nature of the buildings thermal response, hourly recorded weather data is used in dynamic thermal simulations. Such weather data contains records of radiation, temperature, humidity, sunshine duration and additionally wind speed and direction.

A CIBSE Test Reference Year (TRY) for London Weather Centre has been used for this analysis as per the National Calculation Method requirements.

4.0 Design Criteria

4.1 Built Form

The 3D geometry and building construction materials have been modelled based on the architectural plans and elevations. The 3D model describes the buildings:

- Orientation
- Geometry of building form and all associated exposure of surfaces
- Material constructions
- Windows and glazing

The 3D geometry has been subdivided into generic zone types as per the National Calculation Method (NCM) requirements.

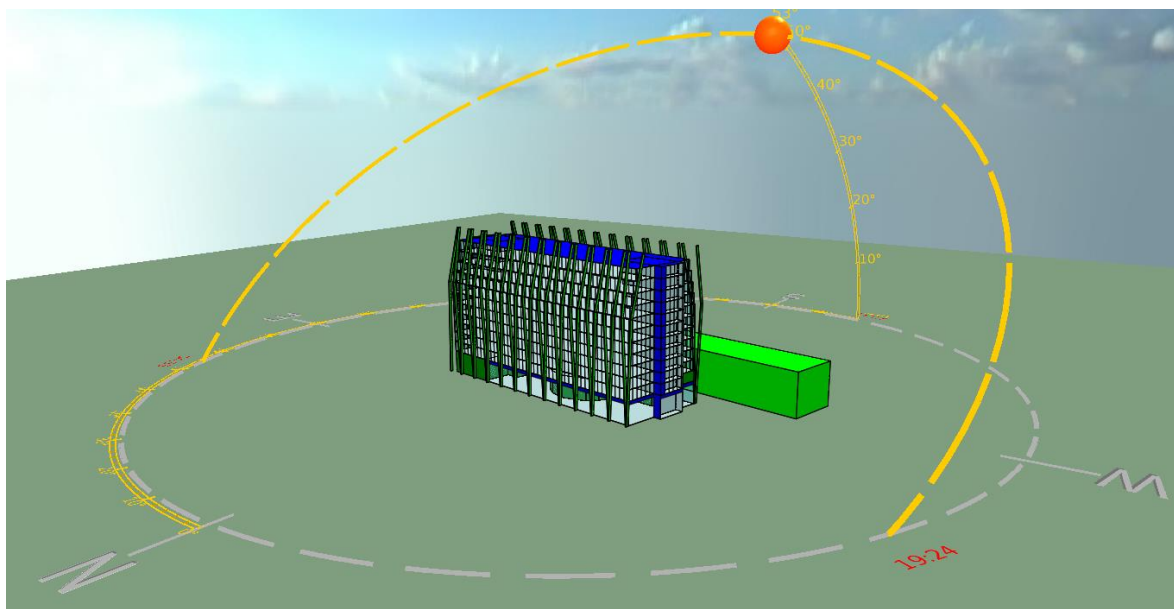


Figure 1: IES model

Please note that the sky garden is not to be considered a conditioned space so that the thermal boundary of the building is at the top of level 11, the model only seeks to simulate conditioned spaces and so the sky garden has been left out the model as shown here.

4.2 Material Constructions

Detailed analysis within the DSM has been completed to determine the impact of various fabric parameters and passive design solutions. The office is to be clad in curtain walling which behaves differently, in thermal terms, from a traditional build up (e.g. rain screen cladding). Because of this we have to address the u-values differently and the limiting u-values for walls within Part L2A do not apply.

There are walls which interface between heated and unheated spaces within the building and these will be of a traditional build up, the car park areas interface with the foyer and some office spaces, as does the plant area. The car park and plant spaces are considered external areas. For this reason any floor area interfacing with these areas must comply with the Ground/Exposed floor U-value.

Construction	Overall U-value (W/m ² K)
Walls to Car park & Plant area	0.18
Ground/Exposed Floor	0.18
Roof	0.15
Curtain Wall Glazing (centre pane)	1.1
Curtain Wall Opaque Area	0.6

Table 2: Fabric Efficiencies

In our calculations we have set the frame factor to zero for the glazing elements of the curtain wall and given the centre pane u-value, please see table 3 below for details of the proposed glazing specification. The architectural Brise Soleil also play an important role in the passive performance of the building.

Glazing Specification (current proposal)	
Name	Pilkington Solar Control 30/17
Colour	Brilliant
Light transmission	30%
G-value	0.19
Gas	Argon filled
Centre Pane u-value	1.1 W/m ² K

Table 3: Fabric Efficiencies

An air permeability of 3 m³/h.m² at 50Pa has been included within the thermal model.

4.3 Building Loads

Building loads determine the heating and cooling requirements of a building. Generic zone types have been assigned a default NCM Operational Template, taken from the Activity Database, which describes these loads.

4.4 Mechanical & Electrical Systems

The building systems described below have been included in the thermal model:

4.4.1 Heating

Areas Served – All Areas	
System	Gas fired Condensing Boilers
Emitter	Fan Coil Unit
Seasonal efficiency	95%

Table 4: Heating Systems

4.4.2 Cooling

Areas Served – All Areas	
System	Water Cooled Chiller
Emitter	Fan Coil Unit
Minimum Seasonal Efficiency (SEER)	5.05

Table 5: Cooling Systems

4.4.3 Ventilation

Areas Served All Areas	
Local Mechanical Ventilation SFP	0.3 W/l/s
AHU Heat Recovery efficiency	85%

Table 6: Ventilation

4.4.4 Lighting

Areas Served – All Areas	
Power Density	11 W/m ²
Illuminance Control	Yes
Different Sensor to Back Half	Yes
Daylight Zoning	Yes
Occupancy	Manual On / Auto Off

Table 7: Artificial Lighting

5.0 Planning Policy Compliance

5.1 BREEAM

Policy CS1 and the Sustainable Design and Construction SPD state a minimum target of BREEAM Very Good however the scheme is targeting a certificate of Excellent, please see appendix B for the full BREEAM pre-assessment. A target score of 74% has been identified and this exceeds the required 3% buffer as stated in the SPD.

The BREEAM target of Excellent has a minimum standard relating to energy performance and this has been achieved by the strategy laid out in this document.

BREEAM Energy Requirement	
Minimum Number of Credits	5
Predicted Number of Credits	9

Table 8: BREEAM Energy Requirements

5.2 Sustainability Statement

The SPD contains an appended checklist containing a list of considerations that are to be addressed to ascertain the overall approach to sustainability. These points are based entirely on the BREEAM section structure and as such the response to each of the items can be found in the corresponding sections of the BREEAM pre-assessment in appendix B of this Energy Strategy.

5.3 Energy Performance

The design incorporates passive design features and high efficiency M&E plant to achieve compliance beyond the current Building Regulations. The glazing specification helps reduce solar gain with a low solar transmission (g-value = 0.19) and the external Brise Soleil provide additional shading to boost the passive performance of the fabric to reduce solar gain and bring down the cooling loads. All the spaces are shown to be passing criterion 3 (Limiting Solar Gains) by at least 35%, please see the BRUKL in appendix A.

These measures alongside the efficient M&E plant have afforded us a considerable pass above the level required by Part L2A, for this reason it is deemed unnecessary to include additional low zero carbon technologies given the already high performance of the building. In addition, the SPD states that the 20% carbon reduction requirement from Low zero carbon technologies is no longer in place. The following table summarises the carbon reduction when compared against the baseline scenario:

Target Emission Rate Part L 2013 TER (kgCO ₂ /m ²)	Building Emission Rate Part L 2013 BER (kgCO ₂ /m ²)	% reduction
21.3 kgCO ₂ /m ²	17.3 kgCO ₂ /m ²	18.7%

Table 9: CO₂ and Energy Reduction

Appendix A

Part L BRUKL Report

BRUKL Output Document



Compliance with England Building Regulations Part L 2013

Project name

The Arc Reading

As designed

Date: Tue Sep 05 10:55:56 2017

Administrative information

Building Details

Address: Napier Road, Reading.

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.7

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.7

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

Owner Details

Name: Lochailort Investments

Telephone number: 02034684933

Address: Cassini House, 57 St James Street, St James's, London, SW1A 1LD

Certifier details

Name: TÜV SÜD

Telephone number: 02078210800

Address: 22 Chapter Street, London, SW1P 4NP

Criterion 1: The calculated CO₂ emission rate for the building must not exceed the target

CO ₂ emission rate from the notional building, kgCO ₂ /m ² .annum	21.3
Target CO ₂ emission rate (TER), kgCO ₂ /m ² .annum	21.3
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	17.3
Are emissions from the building less than or equal to the target?	BER ≤ TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	Surface where the maximum value occurs*
Wall**	0.35	0.4	0.6	RM000000:Surf[4]
Floor	0.25	0.18	0.18	RM000000:Surf[0]
Roof	0.25	0.15	0.15	RM000000:Surf[1]
Windows***, roof windows, and rooflights	2.2	1.1	1.1	RM000000:Surf[2]
Personnel doors	2.2	-	-	No Personnel doors in building
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

U_{a-Limit} = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.

** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

*** Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m ³ /(h.m ²) at 50 Pa	10	3

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the [Non-Domestic Building Services Compliance Guide](#) for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- Fan Coil System

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.95	5.05	0	0.3	0.85
Standard value	0.91*	4.7	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					
^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.					

"No HWS in project, or hot water is provided by HVAC system"

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]										HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		Zone	Standard
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1			
Foyer	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A
Office	-	-	-	-	-	-	-	0.3	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			General lighting [W]
	Luminaire	Lamp	Display lamp	
Standard value	60	60	22	
Foyer	-	60	90	10431

[illegible]

General lighting and display lighting		Luminous efficacy [lm/W]			General lighting [W]
Zone name		Luminaire	Lamp	Display lamp	
	Standard value	60	60	22	
Office		39	-	-	23832
Core Area		-	59	-	395
Core Area		-	59	-	399
Office		39	-	-	22648
Core Area		-	59	-	395
Core Area		-	59	-	399
Office		39	-	-	21127
Core Area		-	59	-	395
Core Area		-	59	-	399
Office		39	-	-	19136
Core Area		-	59	-	395
Core Area		-	147	-	83
Core Area		-	147	-	83
Office		39	-	-	12919

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Foyer	NO (-52.8%)	NO
Office	NO (-40.5%)	NO
Office	NO (-38.6%)	NO
Office	NO (-38.7%)	NO
Office	NO (-38.8%)	NO
Office	NO (-38.8%)	NO
Office	NO (-38.1%)	NO
Office	NO (-37.7%)	NO
Office	NO (-38.1%)	NO
Office	NO (-38.6%)	NO
Office	NO (-38.9%)	NO
Office	NO (-64.1%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters			Building Use	
	Actual	Notional	% Area	Building Type
Area [m ²]	27299.7	27299.7		A1/A2 Retail/Financial and Professional services
External area [m ²]	16632.5	16632.5		A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
Weather	LON	LON	100	B1 Offices and Workshop businesses
Infiltration [m ³ /hm ² @ 50Pa]	3	3		B2 to B7 General Industrial and Special Industrial Groups
Average conductance [W/K]	11514.3	0		B8 Storage or Distribution
Average U-value [W/m ² K]	0.69	0		C1 Hotels
Alpha value* [%]	10	10		C2 Residential Institutions: Hospitals and Care Homes
* Percentage of the building's average heat transfer coefficient which is due to thermal bridging				C2 Residential Institutions: Residential schools
				C2 Residential Institutions: Universities and colleges
				C2A Secure Residential Institutions
				Residential spaces
				D1 Non-residential Institutions: Community/Day Centre
				D1 Non-residential Institutions: Libraries, Museums, and Galleries
				D1 Non-residential Institutions: Education
				D1 Non-residential Institutions: Primary Health Care Building
				D1 Non-residential Institutions: Crown and County Courts
				D2 General Assembly and Leisure, Night Clubs, and Theatres
				Others: Passenger terminals
				Others: Emergency services
				Others: Miscellaneous 24hr activities
				Others: Car Parks 24 hrs
				Others: Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	9	4.12
Cooling	3.58	7.57
Auxiliary	10.34	10.67
Lighting	15.26	20.97
Hot water	2.67	2.65
Equipment*	36.46	36.46
TOTAL**	40.85	45.99

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	81.23	116.09
Primary energy* [kWh/m ²]	101.58	125.65
Total emissions [kg/m ²]	17.3	21.3

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

Appendix B

BREEAM Pre-Assessment

Issue / Revision Record

Issue	Date	By	Checked	Comment
1	25.08.17	AA	JH	Issued for comment
2	01.09.17	AA	RG	Second Issue
3	15.06.17	AA	JH	Final Issue for Planning

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We aim to be the pre-eminent provider of quality building services solutions and the best to work with, in the view of our clients, partners and colleagues. We believe in a sustainability led approach to design for the benefit of our clients and the world we live in.

It is our ultimate goal to work closely with our fellow professionals and clients to minimise carbon emissions and to deliver a better environment for us all to live in.

Contents

	Page
1.0 Pre-Assessment Estimate	3
2.0 Introduction	4
3.0 Pre-Assessment	8
4.0 Summary	21

1.0 Pre-Assessment Estimate

This document is intended to outline a series of appropriate credits which if achieved will allow The Arc office development to gain the targeted BREEAM rating of 'Excellent'.

Following a feasibility study individual credits were selected in order to achieve the targeted BREEAM rating under a 'New Construction 2014 Shell & Core' assessment.

The following credits are mandatory for an 'Excellent' rating and have therefore been included:

BREEAM Issue	Minimum Standards for Excellent
Man 3– Responsible Construction Practices	1
Man 4 – Commissioning and Handover	Criterion 9 (Building User Guide)
Man 5 – Aftercare	1 (Seasonal Commissioning)
Ene 1 – Reduction of Energy Use and Carbon Emissions	5
Ene 2 – Energy Monitoring	1 (First sub-metering credit)
Wat 1 - Water consumption	1
Wat 2 - Water monitoring	Criterion 1 only
Mat 3 – Responsible Sourcing	Criterion 1 only
Wst 3 – Operational Waste	1
LE 3 – Mitigating ecological impact	1

Table 1 – BREEAM Mandatory Standards

A target score of **73%**, an '**Excellent**' rating was determined.

BREEAM specific reports will be required in the following areas of expertise:

- Acoustics
- Flood risk / flood defence reporting
- Security Specialist (CPDA)
- Ecologist
- Daylight study

The results of the Pre-Assessment are included within this report along with details of the credit criteria that the design and procurement must achieve.

A number of additional credits were identified for investigation and these are included within this report.

2.0 Introduction

2.1 The Arc

The Arc is to be a flagship office development in the heart of Reading in the Thames Valley with a striking glazed façade and a sky garden giving stunning views. This pre-assessment will lay out how the development will be a flagship of sustainability as well as being an architectural masterpiece.

2.2 The Assessment

Under the 2014 BREEAM assessment scheme there are three separate types of assessment:

- Shell only
- Shell & core
- Fully fitted

Each varies in its scope with regard to which BREEAM criteria are included. Shell assessments include the least amount of credits because it is assumed that none of the building services will be installed. Shell and core includes all of the building services but excludes the finishes and the fully fitted option includes every credit.

There is no flexibility concerning which credits can be included in the chosen option, even where certain credits fall out of the developers' scope of works. Instead a collaborative approach is required with the fit-out teams.

BREEAM have recently released a fit-out BREEAM assessment which can be used to assess the credits not included when a 'shell' or 'shell and core' assessment was used in the first instance.

The office is to be finished to a Category A standard which will include all the building services in the scope of works so a shell and core option would be most appropriate.

To fulfil the necessary evidence requirements the landlord project team will be required to act on the requests of the assessor so that a robust set of evidence can be presented in support of the final report. BRE will audit the report submission and the associated evidence and will flag any areas where further detail is required.

The target score of **73%** provides a buffer allowing an '**Excellent**' score and if some credits are lost in the design and construction process additional credits could be targeted.

2.3 BREEAM Categories

The BREEAM New Construction 2014 scheme awards credits in 9 separate sections which relate to the construction, design and procurement decisions made on a project:

- Management – commissioning, site practices, education and training of building users.
- Health and Wellbeing – natural ventilation, daylighting and occupant controls.
- Energy – carbon emissions, heating and lighting control, energy monitoring, use of daylight and provision of shading.
- Transport – car parking provision, cyclist facilities and public transport.
- Water – leak detection, water meters, low flush toilets and grey water use.
- Materials – specification of building material and prohibition of hazardous substances.
- Waste – waste management, waste recycling.
- Land Use and Ecology – existing and enhanced ecological value of the site.
- Pollution – pollution monitoring, ozone depleting substances and NOx emission rates.

2.4 BREEAM Credits for Innovation

Innovation credits provide additional recognition for a building that innovates in the field of sustainable performance, above the level that is currently recognised in BREEAM.

An additional 1% score can be added to a building's final BREEAM score for each innovation credit achieved, up to a maximum of 10%.

Innovation credits can be achieved by meeting exemplary performance requirements or by making an application to BRE based on a particular building feature, system or process.

2.5 Explanation of Scoring

Each category is weighted differently to reflect the relative significance that it has on the environmental impact of the building as follows:

BREEAM Section	Weighting (%)		
	Fully Fitted	Shell Only	Shell & Core
Management	12%	12.5%	11%
Health & Wellbeing	15%	10%	10.5%
Energy	15%	14.5%	15%

BREEAM Section	Weighting (%)		
	Fully Fitted	Shell Only	Shell & Core
Transport	9%	11.5%	10%
Water	7%	4%	7.5%
Materials	13.5%	17.5%	14.5%
Waste	8.5%	11%	9.5%
Land Use & Ecology	10%	13%	11%
Pollution	10%	6%	11%
Innovation (additional)	10%	10%	10%

Table 2 – Environmental Weightings

For each BREEAM section the number of credits achieved, as determined by the BREEAM Assessor, is converted into a percentage of the total credits available for the section.

This percentage is then multiplied by the section weighting, giving the section score.

Each section score is then added together to give the overall BREEAM score (as a percentage).

The BREEAM score then determines the BREEAM rating as described in the table below:

BREEAM Rating	Minimum Score Required
Unclassified	<30%
Pass	≥30%
Good	≥45%
Very Good	≥55%
Excellent	≥70%
Outstanding	≥85%

Table 3 – BREEAM 2014 Rating Benchmark

2.6 Minimum Performance

To achieve a BREEAM rating, the minimum percentage score must be achieved, as described above, and the minimum standards (i.e. number of credits achieved) applicable to that rating level complied with as outlined in the table below:

BREEAM Issue	BREEAM Rating / Minimum number of credits				
	Pass	Good	Very Good	Excellent	Outstanding
Man 3 – Responsible Construction Practices	-	-	-	1	2
Man 4 – Commissioning and Handover	-	-	-	Criteria 9	Criteria 9
Man 5 - Aftercare	-	-	-	1 (seasonal Comm.)	1 (seasonal Comm.)
Ene 1 – Reduction of CO2 Emissions	-	-	-	5	8
Ene 2 – Energy Monitoring	-	-	1	1	1
Wat 1 - Water consumption	-	1	1	1	2
Wat 2 - Water Monitoring	-	Criteria 1	Criteria 1	Criteria 1	Criteria 1
Mat 3 – Responsible Sourcing	Criteria 1	Criteria 1	Criteria 1	Criteria 1	Criteria 1
Wst 1- Construction waste management	-	-	-	-	1
Wst 3 – Operational Waste	-	-	-	1	1
Le 3 – Mitigating ecological impact	-	-	1	1	1

Table 4 – Minimum BREEAM Standards

2.7 Minimum BREEAM Certification

The project will be assessed and verified at Design stage at which point an interim design certificate will be issued by BRE. Full certification will only be achieved following the Post Construction assessment.

3.0 Pre-Assessment

3.1 Management

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Man 01	Project Brief and Design	Up to four available where the following is achieved: 1. Will roles, responsibilities and contributions be defined for the key phases of the project? 2. ~~Will an appropriate level of third party consultation activities be undertaken?~~ 3. ~~Will a BREEAM AP/ Sustainability Champion be appointed at RIBA stage 1 and performance targets formally agreed?~~ 4. ~~Will a BREEAM AP / Sustainability Champion be appointed to monitor and report progress throughout the design process~~	4	1	-
Man 02	Life Cycle Cost and Service Planning	Up to four credits available where the following is achieved: 1. ~~Will an elemental life cycle cost analysis be carried out? (2 credits)~~ 2. ~~Will a component level life cycle cost analysis be carried out?~~ 3. Will the capital cost of the project be reported as part of the assessment?	4	1	-
Man 03	Responsible Construction Practices	Up to six credits available where the following is achieved: 1. Is all site timber legally harvested and traded timber? 2. Will the principal contractor operate a compliant Environmental Management System AND will the principal contractor adopt best practice pollution prevention policies and procedures? 3. Will the contractor score 35 or more in the considerate constructors scheme? 4. Will a sustainability champion be named by the contractor to monitor and report against the responsible construction practices? 5. Will site water and energy consumption be metered / monitored?	6	6	-

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
		6. Will the transport of construction materials and waste to / from site be measured / monitored?			
Man 04	Commissioning and Handover	Four credits are available where the following is achieved: 1. Will a schedule of commissioning accounted for in the main programme and will the commissioning responsibilities be defined? 2. Will a specialist commissioning manager be appointed to oversee the commissioning of the complex building services? 3. Will the contractor account for the commissioning of the building fabric (thermographic survey) and will any defects be rectified? 4. Will a building user guide and training schedule be prepared for the building occupiers? *Thermographic survey is required to test for heat leakage paths for the office space*	4	4	-

Note: ~~Strikethrough~~ text indicates this portion of the credit is not targeted.

3.2 Health & Wellbeing

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Hea 01	Visual Comfort	Up to five credits available where the following is achieved: All fluorescent lamps are fitted with high frequency ballasts, AND 1. Will adequate glare control be installed in all occupied spaces? 2. Will the building meet the relevant daylighting criteria? 3. Will all the areas of the building meet the relevant view out criteria? 4. Will external lighting be specified in accordance with BS 54891-:2011 *Daylight study required*	4	4	-
Hea 02	Indoor Air Quality	Two credits are available where the following is achieved: ~~1. Will the ventilation ducting design comply?~~ ~~Will the Ventilation strategy comply with BS EN 13779:2007 Annex A2 and will filtration systems be in line with Annex A3?~~ ~~2. Will the building have the potential for natural ventilation?~~	2	0	1
Hea 04	Thermal Comfort	Two credits are available where the thermal comfort strategy is based on thermal modelling: 1. Will thermal modelling of the design be carried out? 2. Has the thermal modelling included a projected climate change scenario?	2	2	-
Hea 05	Acoustic Performance	One credit available where the building performs acoustically:	1	1	-

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
		1. Will a suitably qualified acoustician be appointed to provide appropriate design advice? 2. Will the building meet the relevant acoustic performance standards in BS 8233:2014?			
Hea 06	Safety and Security	Two credits are available for safe access and secure design: 1. Will a suitably qualified security consultant be appointed and will they conduct a security needs assessment and will their security considerations be accounted for? 2. Will cycle lanes connect to the cycle storage? **No.1: A security specialist (CPDA) should be consulted at stage 2 to draft a Security Needs Assessment. **	2	2	-

Note: ~~Strikethrough~~ text indicates this portion of the credit is not targeted.

3.3 Energy

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Ene 01	Reduction of energy use and CO ₂ Emissions	Up to twelve credits are available for the reduction of carbon dioxide emissions	12 (+5 Innovation)	9	-
Ene 02	Energy Monitoring	Two credits are available where the energy consuming systems and functional areas are metered: 1. Where a system accounts for 10% of the buildings energy consumption per fuel type will it be metered with a pulsed output and labelled ** This credit is a minimum requirement**	2	2	-
Ene 03	External Lighting	Will external light fittings and controls be specified in accordance with BREEAM criteria?	1	1	-
Ene 04	Low and Zero Carbon Technology	Up to three credits are available for the inclusion of a Low / Zero carbon technology. 1. Will a passive design analysis be carried out? 2. Will a feasibility study be carried out and will low and zero carbon technologies be specified? 3. ~~Can free cooling be achieved for the building?~~	3	2	-
Ene 06	Energy Efficient Transportation systems	Up to three credits are available energy efficient lifts and escalators: 1. Will a transportation system analysis be carried out to determine the optimum number and size of lifts / escalators? 2. Will energy-efficient features offering the greatest potential energy savings be specified for the systems? * The lifts will be designed to BREEAM standards *	3	3	-

Note: ~~Strikethrough~~ text indicates this portion of the credit is not targeted.

3.4 Transport

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Tra 01	Public Transport Accessibility	Up to five credits are available for close proximity to good public transport networks: 1. What is the Building's indicative Accessibility Index?	3	3	-
Tra 02	Proximity to amenities	One credit available where the building is located in close proximity of and accessible to applicable amenities?	1	1	-
Tra 03	Cyclist facilities	Up to two credits are available for the provision of dedicated cyclist facilities: 1. Will cycle storage spaces be provided for staff and for customers? 2. Will cyclist showers, lockers and changing facilities be provided? * Cycle parking provision has been integrated into the design and exceed the local authorities minimum standards *	2	2	-
Tra 4	Maximum Car Parking Capacity	Up to two credits are available where the level of car parking is limited to promote sustainable travel to site. The thresholds are linked to the sites accessibility index described in Tra 1.	2	2	-
Tra 05	Travel Plan	One credit available where a transport plan based on site specific travel survey/ assessment is developed?	1	1	-

Note: Strikethrough text indicates this portion of the credit is not targeted.

3.5 Water

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits												
Wat 01	Water Consumption	Up to five credits are available for water fittings and recycling systems that reduce the water consumption for the building: <table><tr><th>% improvement</th><th>No. of BREEAM credits</th></tr><tr><td>12.5</td><td>1</td></tr><tr><td>25</td><td>2</td></tr><tr><td>40</td><td>3</td></tr><tr><td>50</td><td>4</td></tr><tr><td>55</td><td>5</td></tr></table> ** THIS IS A MINIMUM REQUIREMENT. Sanitaryware spec must be analysed by the assessor for flow rate compliance**	% improvement	No. of BREEAM credits	12.5	1	25	2	40	3	50	4	55	5	5	2	1
% improvement	No. of BREEAM credits																
12.5	1																
25	2																
40	3																
50	4																
55	5																
Wat 02	Water Monitoring	One credit can be awarded where the building's water consumption is monitored: - Will there be a water meter on the mains water supply to the building(s)? - Will all specified water meters have a pulsed output?	1	1	-												
Wat 03	Water Leak Detection and Prevention	Two credits are available for leak detection systems: - Will a mains leak detection system be installed on the building's mains water supply? ~~Will flow control devices be attached to each sanitary area?~~	2	1	-												
Wat 04	Water efficient Equipment	One credit is available where unregulated water consumption is reduced as follows: Will the soft landscaping rely solely on natural precipitation or hand watering, or will the irrigation system present be designed to minimise water use?	1	1	-												

Note: Strikethrough text indicates this portion of the credit is not targeted.

3.6 Materials

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Mat 01	Life Cycle Impacts	Up to five credits are available for construction materials with a low environmental impact over the full life cycle of the building (Green Guide ratings). - External Walls - Windows - Upper Floor Slabs - Internal Walls - Floor finishes / coverings	5 (+3 Innovation)	2	-
Mat 02	Hard Landscaping and Boundary Protection	One credit is available if >80 % of all external hard landscaping and boundary protection achieve a Green Guide A or A+ rating.	1	1	-
Mat 03	Responsible Sourcing	All timber used on the project to be sourced in accordance with the UK Govt's Timber Procurement Policy? Up to three credits are available for building elements to demonstrate they have been responsibly resourced, with appropriate Environmental Management Certification. One credit is available where the contractor operates a sustainable procurement plan. ** Suppliers of construction materials will need to have BES 6001 Accreditation ** ** Contractor to have Sustainable Procurement Plan compliant with BS 8903 **	4 (+1 Innovation)	2	-
Mat 04	Insulation	One credit is available where the following is provided: - Has the building targeted an insulating index of 2 or more? - Will the building's insulating materials be responsibly sourced?	1	1	-

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Mat 05	Designing for Durability and Resilience	One credit is available where the following is achieved: 1. Will suitable durability / protection measures be specified and installed to vulnerable areas of the building? 2. Will exposed parts of the building be protected from material degradation?	1	1	-
Mat 06	Material Efficiency	One credit is available where material optimisation measures are investigated and implemented.	1	0	-

Note: ~~Strikethrough~~ text indicates this portion of the credit is not targeted.

3.7 Waste

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Wst 01	Construction Waste Management	Up to four credits are available for a compliant site Waste Management Plan (SWMP): 1. Will a compliant Resource Management Plan be produced? 2. Will a compliant pre-demolition audit be undertaken? 3. What level of Non-hazardous construction waste? 4. What level of Non-hazardous non-demolition construction waste is diverted from landfill? 5. What level of Non-hazardous demolition waste diverted from landfill? ** Resource Management Plan to identify a number of measures to reduce materials waste on site ** **The RMP to target upper limit of 11.1 tonnes/100m² and 80% waste diverted from landfill**	4 (+1 Innovation)	2	-
Wst 02	Recycled Aggregates	~~One credit is available for the use of recycled and secondary aggregates in construction, (>25% of total high grade aggregates).~~	1 (+1 Innovation)	0	-
Wst 03	Operational Waste	One credit is available for the provision of dedicated storage facilities for operation waste streams and recyclable waste in particular.	1	1	-
Wst 04	Speculative Floor and Ceiling Finishes	One credit is available where the developer takes steps to minimise the risk of the incoming tenant condemning the installed floor and ceiling finishes 1. The incoming tenant has specified these finishes OR 2. These finishes are installed in show area only OR 3. No speculative finishes are installed	1	1	-

Wst 05	Adaption to Climate Change	Will the fabric and structure of the building be designed to adapt to climate change? ** Architect and Civil Engineer to report against the resilience of the building against the environmental risks of climate change in the form of a risk assessment. This takes place at stage 2**	1	1	-
Wst 06	Functional adaptability	~~Will a building specific functional adaptation strategy appraisal be carried out by Concept Design stage?~~	1	-	1

Note: Strikethrough text indicates this portion of the credit is not targeted.

3.8 Land Use and Ecology

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
LE 01	Site Selection	Two credits are available where the following is achieved: 1. Will at least 75 % of the proposed development's footprint be located on previously developed land? 2. Is the site deemed to be significantly contaminated?	2	2	-
LE 02	Ecological Value of Site and Protection of Ecological Features	Two credits are available where the following is achieved: 1. Can the land within the construction zone be defined as 'land of low ecological value'? 2. Will all features of ecological value surrounding the construction zone/site boundary be protected?	2	2	-
LE 03	Mitigating Ecological Impact	Two credits are available for increasing the ecological value as a result of the sites development. **Change in Ecological value will be positive **	2	2	-
LE 04	Enhancing Site Ecology	Up to two credits are available where the following is met: 1. Will a suitably qualified ecologist be appointed to report on enhancing and protecting site ecology? 2. Will the suitably qualified ecologist's general recommendations be implemented? 3. Will the improvement in ecological value increase as targeted as a result of the enhancement actions? ** The appointed ecologist is to advise how the second credit can be achieved **	2	2	-
LE 05	Long Term Impact on Biodiversity	Up to two credits are available where the following is met: 1. Will the building meet BREEAM's mandatory criteria for this BREEAM issue? 2. Will a Biodiversity Champion be appointed to	2	2	-

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
		monitor / minimise the impacts of sites activities on biodiversity? 3. Will the contractor provide training for the site workforce on how to protect ecology during the project? 4. Will the contractor record actions to protect biodiversity and monitor their effectiveness during construction? 5. Where flora/fauna habitats exist on site, will the contractor programme site works to minimise disturbance? Awarded by default where none exists			

Note: Strikethrough text indicates this portion of the credit is not targeted.

3.9 Pollution

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
Pol 01	Impact of Refrigerants	Up to 3 credits are available where the space cooling systems have a minimal potential to cause global warming: 1. Will refrigerant containing system be installed in the assessed building? 2. Is the Global Warming Potential of the specified refrigerant(s) likely to be 10 or less? 3. Will the Direct Effect Life Cycle CO₂eq. emissions for the system be less than 1000 per kW coolth capacity? 4. ~~Will a refrigerant leak detection and containment system be specified / installed?~~	3	2	-
Pol 2	NO _x Emissions	Up to three credits are available where low NO_x emissions for space heating and hot water systems have been calculated.	3	0	-
Pol 03	Surface Water Run Off	Up to five credits are available where the surface water run-off of the site is restricted: 1. What is the actual/ likely annual probability of flooding for the assessed site? 2. Will a Flood Risk Assessment be undertaken and ground level of the building / access meets BREEAM criteria? 3. Will the site meeting meet the BREEAM	5	4	-

Ref	Issue Title	BREEAM Criteria	No. Credits Available	No. Credits Proposed	Potential Additional Credits
		criteria for peak rate surface water run-off? 4. Will the site meet the criteria for surface water run-off volume, attenuation and/or limiting discharge? ~~5. Will the site be designed to minimise watercourse pollution in accordance with the BREEAM criteria?~~			
Pol 04	Reduction of Night Time Pollution	One credit is available where the external lighting is designed to reduce light pollution.	1	1	-
Pol 5	Noise Attenuation	Are there noise-sensitive buildings within 800m of the development? Will a noise impact assessment be commissioned to assess the installed plant and will attenuation measures be specified where necessary?	1	1	-

Note: Strikethrough text indicates this portion of the credit is not targeted.

4.0 Summary

The results of the pre-assessment indicate that The Arc, Reading could achieve a score of **73%** an **“Excellent”** Rating

BREEAM UK New Construction 2014 Assessment Report: Rating & Key Performance Indicators **BREEAM® UK**

Building name	The Arc, Reading
BREEAM rating	Excellent
Total Score	73.0%
Min. standards level achieved	Outstanding level

Building Performance by Environment Section

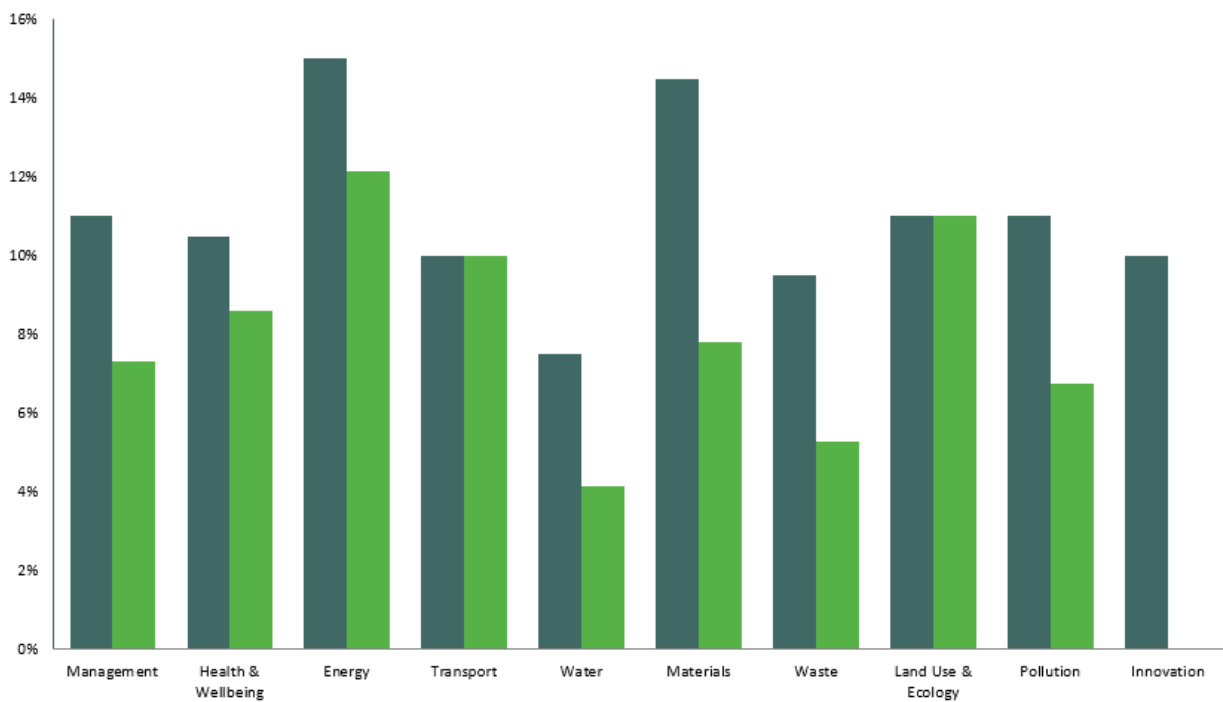


Image 1 - Predicted BREEAM Score



Wallace Whittle

**Choose certainty.
Add value.**

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