Environmental Sustainability Plan

Building Q2

King's Cross Central
General Partner Ltd

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King's Cross

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1 Glossary

AD	Approved Documents (Building Regulations)
AHU	Air Handling Unit
BER	Building Emission Rate
BREEAM	Building Research Establishment Environmental Assessment Method
CHP	Combined Heat & Power Generation
CCHP	Combined Cooling, Heat & Power Generation (Tri-Generation)
CO_2	Carbon Dioxide
DE	District Energy
DHW	Domestic Hot Water
ESCO	Energy Service Company
GREEN GUIDE	The 'Building Research Establishments Green Guide to Specification (3rd Edition)
GLA	Greater London Authority
LTHW	Low Temperature, Hot Water
PV	Photovoltaic Cells/Panels
S106	Deed of Planning Obligations Pursuant to Section 106 of the Town and Country Planning Act 1990
TER	Target Emission Rate
TIMSA	Thermal Insulation Manufacturers and Suppliers Association
HVAC	Heating, Ventilation & Air-Conditioning
Part L2	This refers to 'Approved Document L2A' of the building regulations which sets down the minimum performance and energy efficient measures which will have to be achieved by the King's Cross Central Zone B buildings.

2 Introduction

This Environmental Sustainability Plan describes the strategies that have been included within the design of Building Q2 in response to the planning conditions of the King's Cross Central ('KXC') outline planning permission (ref. 2004/2307/P) dated 22 December 2006 (the 'Outline Planning Permission'). In particular, this document provides information in response to conditions 17, 45, and 60 of that permission, giving details of the strategies adopted and demonstrating that the building achieves a very high standard of sustainability for a development of this scale in an urban environment. The plan also details how obligations contained within sections AA, Y and Z of the KXC Section 106 Agreement will be met.

This Plan should be read in the context of the other plans and documents forming Building Q2 submission, including the Urban Design Report, the Planning Compliance Report and BREEAM pre-assessment, the latter being included within this document in Appendix B.

3 Executive Summary

Plot Q2 forms part of Development Zone Q within the northern part of the KXC site. It is a trapezoidal-shaped site bounded by Plot Q1 to the south, York Way to the east and Wilberforce Street to the west. A new recreation space, referred to as Gatti Park, will be provided immediately to the north between Buildings Q2 and R4 (known as Rubicon Court). This space is outside the scope of the current submission and details will be submitted separately for approval at a later date.

Building Q2 has been designed to be occupied in two phases. In its 'initial state', Building Q2 will accommodate a temporary Construction Training Centre at lower ground floor, replacing the current facility on the Triangle Site. In the 'permanent state', the building will provide a public indoor sports hall and fitness suite (Class D2) across both levels. The building will be provided as shell and core, to be fitted out by the respective occupiers at each phase.

Building Q2 will achieve a very high standard of sustainability. In its permanent state, the building will accommodate public sports and leisure uses, and as such, the building has been registered since concept design stage under the BREEAM UK New Construction 2014 Shell and Core Leisure Centre and Sports Hall scheme. The building is expected to achieve a BREEAM minimum rating of 'EXCELLENT', with an aspiration to achieve 'OUTSTANDING'.

The combination of energy efficient measures and the sourcing of heat and power from the low-carbon district energy system will result in an overall annual carbon reduction in excess of 60% relative to the baseline energy model's Part L Target Emissions Rate.

In summary, the main environmental and sustainability measures that are proposed include but are not limited to, the following:

Condition 17(A) Energy efficiency measures

- A holistic approach towards sustainability, reviewing all aspects relating to the management and operation of the building, both during the construction process, and also giving due consideration to the specified systems and flexibility available to an incoming tenant.
- Emphasis on passive design measures, building services system efficiencies and a comprehensive metering strategy enabling interrogation of electrical, gas and water usage to reduce energy consumption. Detailed thermal modelling has been carried out to optimise facade design in conjunction with internal thermal mass benefits via the specified exposed concrete soffit and the specification of the proposed building services systems.
- An enhanced building envelope thermal performance through the specification of 'better-than' Part-L minimum limiting parameters for fabric U-values and air permeability.
- The adoption of effective passive design techniques such as optimising façade solar performance to respond to any benefits from natural sources of shading (for example, by the neighbouring R7 / R8 etc buildings) to minimise direct solar gain whilst ensuring good levels of natural daylight within the occupied areas.
- The installation of an intelligent Control System to monitor and control the building's energy performance and comfort conditions.
- The installation of energy efficient lighting with a high efficacy and intelligent controls, including

presence detection and daylight dimming to greatly reduce the electrical consumption of the artificial lighting installation.

Condition 17(B) Reduction in carbon emissions

- Excluding the contribution of the low-carbon district energy system, the achievement of carbon emissions 6 % lower than the baseline energy model's Target Emissions Rate through the use of good passive building design, energy efficient system selection and intelligent control methodologies

Condition 17(C): Provision of Green / Brown roofs

- The proximity of the Victorian Gasworks Tunnels impose significant loading constraints on the building, preventing the introduction of green or brown roofs which would add additional weight to the structure. Consequently, green/brown roofs are not proposed for this building.

Condition 17(D): Energy supply

- The connection of Building Q2 to the KXC district energy system allows it to take advantage of the low-carbon benefits associated with combined heat and power. The district energy system will meet all of the heating and hot water demand for the building. It will also generate electrical power which will be fed into the National Grid, thereby offsetting a significant percentage of the buildings demand.
- The use of a low-carbon energy supply and the aforementioned passive design measures, energy efficient systems selection and intelligent controls result in Building Q2 achieving an overall reduction in CO2 of 60% against the baseline energy model's Target Emissions Rate.

Condition 17(E): BREEAM Rating

- As stated above, an initial BREEAM 2011 pre-assessment has been carried out and it has identified that the building design has an indicative potential score of 85.5%, representing an 'Outstanding' BREEAM rating.

Condition 45: Drainage

- The site-wide drainage networks and overall strategy has been designed using SUDS principles to provide an overall peak flow reduction of 10% (based on a 1 in 30 year storm). The site-wide drainage strategy has set maximum peak flow limits to each plot to ensure that the site-wide maximum discharge to the existing combined sewer will not exceed 2292 l/s. Building Q2 will be designed so that the foul and surface water discharges will not exceed these set limits.

S106 - Section AA: Water

- The proposals include the installation of low water use sanitary ware fittings to reduce the internal water use.

S106 - Section Y: Construction materials and waste

- The minimisation of packaging used to protect construction materials and assemblies in transportation. Any packaging will be returned wherever possible to be re-used. In addition, to minimise site wastage at the construction phase, prefabrication off-site will be utilised whenever possible.
- A BREEAM rating of 'Excellent' will be the principal driver for the team's endeavours to achieve the best possible performance against the Construction Targets
- An early appraisal of the likely construction materials and their embodied energies has been undertaken. Materials with low levels of environmental impact will be specified wherever practicable. In addition, to minimise site wastage at the construction phase, prefabrication will be utilised whenever possible.

Response to Planning Conditions

3.1 Condition 17 (A): Energy Efficiency Measures

"The Environmental Sustainability Plan shall explain how the proposed building design realises opportunities to include design and technology energy efficiency measures"

3.1.1 Design Philosophy

Building Q2 has been designed with energy efficiency being one of the key drivers from the outset.

Whilst the offsetting of electrical energy and the heating supplies to each building will be provided via the low-carbon KXC Energy Centre, the project team recognise the need to reduce energy consumption demand of both the building and its users through the application of the following design methodologies:

- **Passive Design** - The use of the building structure (thermal mass) and the development of the façade systems to respond to their orientation and relation to sun angles to minimise cooling loads and artificial lighting energy demand.

- **Active Design** - The specification of energy efficient equipment (for example, intelligent and high efficacy lighting systems, variable speed pumping etc.) all linked and monitored via the Building Energy Management System, to reduce energy consumption when the building is in use.

By embracing passive and active design, Building Q2 will also be 'future-proofed' to ensure it is adaptable to climate change and the future operational needs of the tenant, and is capable of accommodating future low/zero carbon technologies.

3.1.2 Passive Design

Figure 1 – Site Location Plan

Physical Form of the Building

Plot Q2 forms part of Development Zone Q within the northern part of the KXC site, shown on Figure 1 adjacent. It is a trapezoidal-shaped site bounded by Plot Q1 to the south, York Way to the east and Wilberforce Street to the west. Buildings R7 and R8 will sit opposite Q2 on Wilberforce Street. R7, an office building, and R8, a predominantly residential building with office and retail at the lower levels, have both received Reserved Matters approval. R7 is now under construction. A new recreation space called Gatti Park will be created immediately to the north of Q2. Rubicon Court (formerly known as R4), a fully occupied residential building, sits to the north of this space.

Building Q2 is a two storey building comprising a lower and an upper ground floor. Its height and mass are informed by loading constraints imposed by the Gasworks Tunnels which run below the site, requiring a low, lightweight building. The position of the sports hall to the south of the building in an east-west orientation is also essentially fixed by the minimum dimensions specified in the Section 106 Agreement and by Sports England Guidance, and the size of the plot. This has been the starting point for the internal layout and thus the building form, with the fitness suites located at the northern end of the building with views over Gatti Park and ancillary facilities (which require less daylight) in the centre.

In its permanent state, the building will house public sports facilities for the Camden Council, namely a double height sports hall and fitness suite at lower ground floor and a further fitness suite at upper ground floor level, alongside ancillary changing

facilities, plant and administrative functions spread across both levels. The main entrance is located at lower ground floor level on Wilberforce Street.

In the short term, the lower ground floor level will be fitted out as a Construction Training Centre (CTC), replacing the current facility on the Triangle Site, before being converted to its final use as a sports hall and fitness centre for Camden Council.

During the temporary CTC phase, the sports hall will house workshop areas, classrooms, offices and admin areas for staff. A fitness suite with associated changing facilities will still be provided at upper ground floor level during this time.

Façade Design
The external envelope of a building can act as an important climatic modifier, with a well-designed facade significantly reducing the building's energy demand.

High levels of insulation will limit the heat loss through the floor, walls and roof of the new building. U-values (heat transfer coefficients) have been reduced, giving a significant improvement compared to the minimum requirements set out in Building Regulations.

Building Element	Part L 2013 U-Value (W/m^2K)	Building Q2 Design U-Values (W/m^2K)
Ground Floor	0.25	0.18
External Walls	0.35	0.14
Roof	0.25	0.09
Glazing	2.2	1.45
Infiltration ($m^3/(m^2.h)$ at 50Pa)	10	2.5

As noted above, the location of the sports hall in the southern half of the building has heavily influenced the design of the building, including the distribution of uses and thus windows. Dynamic thermal modelling using industry standard-modelling software has been used throughout the design process to optimise the glazing areas around the building, ensuring good levels of natural daylight penetration whilst limiting unwanted heat loss and solar gain. The proposed facades and distribution of windows are shown in the elevations as Figures 2, 3 and 4 below.

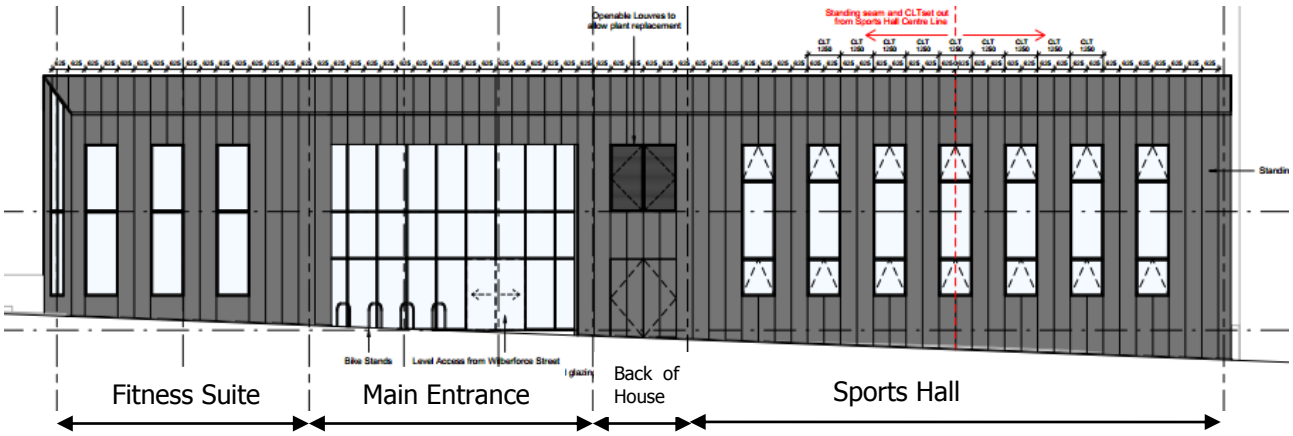


Figure 2 – West Elevation

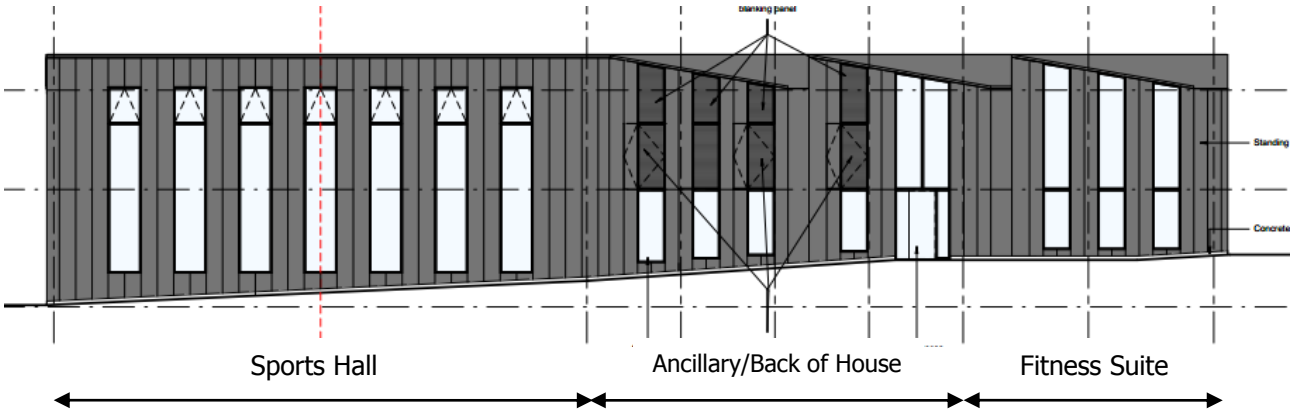


Figure 3 – East Elevation

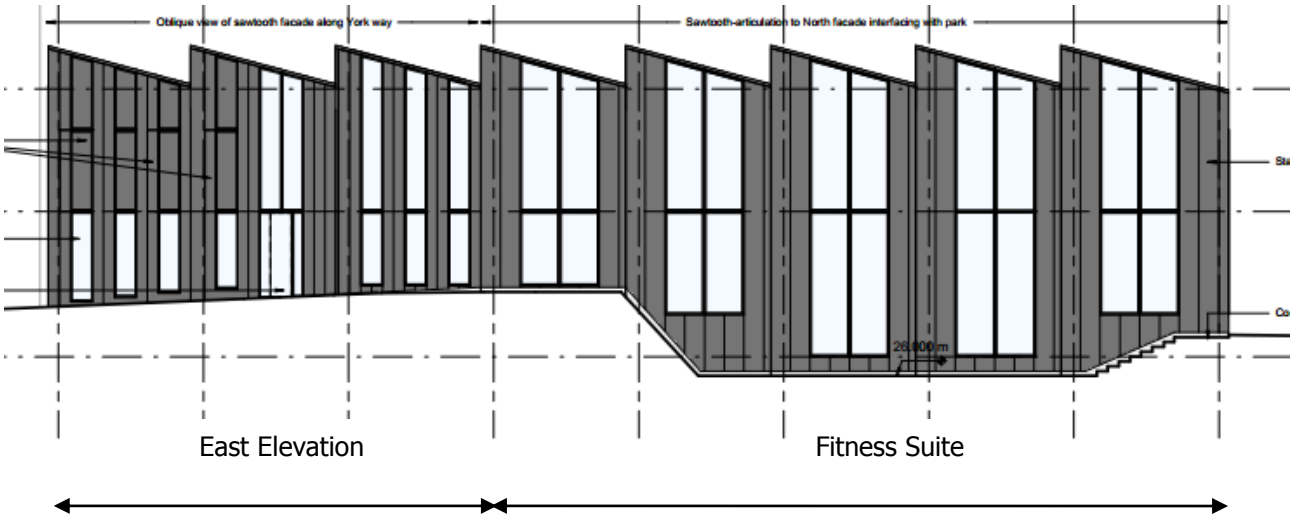


Figure 4 – North Elevation

The west façade faces Buildings R7 and R8 which, when built, will be substantially taller than Building Q2 (around 12 storeys compared to Q2's two storeys) minimising the effect of evening solar gains. In contrast, the east façade faces onto York way, a relatively open main road with low-rise buildings on the opposite side.

Additionally, windows on the east and west facades have been recessed in by over 250mm which will aid in reducing solar gains. Solar control glazing with a g-value of 0.37 will be used on both the east and west facades of the building. For the north façade the g-value has been relaxed to 0.59 due to the direct solar gain on this façade being less significant than the other facades.

Within the sports hall, the design allows for the installation of internal blinds primarily to avoid glare during sports such as badminton, but these will also help to reduce solar gain further during the summer. The specification of these blinds will be determined by the occupier at the fit-out stage and so have not been included in the thermal modelling.

Thermal Mass

Due to the proximity of the Gasworks Tunnels and the associated loading constraints, Building Q2 has been designed using a lightweight structure of cross-laminated timber (CLT). Aesthetically, this structure will be on show as the final surface finish within the majority of spaces. Although less than concrete, CLT still has a certain level of inherent thermal mass which will aid slightly in buffering the temperatures within the building.

Natural Ventilation

During the CTC phase the main workshop space will be designed so that summer temperatures are reduced using natural ventilation. This method dramatically reduces the energy required to keep the space cool but

also provides a comfortable level of air movement during summer months for the building occupants.

High and low level automatic openings on Wilberforce Street combined with high level automatic openings, linked to the control system, on York Way will provide a decent level of cross ventilation. This will allow the space to remain comfortable for most of the year. Manual overrides will allow for the occupants to have control over the space.

In its permanent state as a sports hall and fitness suite, the comfort levels specified (a maximum internal summer temperature of 24°C and an internal noise limit of NR40) are more stringent than for the CTC phase and so a mixed mode approach will be used to control the internal environment. Noise from York Way may require that the windows be closed, for example, reducing the ability to rely on natural ventilation. The sports hall mechanical ventilation with cooling will be provided as part of the sports hall fit-out design and will be linked, along with the automatic window actuators, to a central control system to allow the two ventilation methods to work together and respond to external and environmental factors.

3.1.3 Active Design

Ventilation with heat recovery

The energy required to heat the incoming fresh air supply to the building will be significantly reduced by using a heat recovery system. The heat recovery systems will utilise the thermal properties of the return air to transfer 'free' heat/coolth to the incoming fresh air supply. These will be controlled so as to minimise the demand for any heating and cooling of the fresh air supply.

Mechanical ventilation will be required to WCs, classrooms, changing areas, offices, fitness suites and, during times when natural ventilation is not possible, to the main sports hall. Each mechanical ventilation system shall incorporate a method for heat recovery. This means that during colder months the heat is taken from the extract air and transferred to the supply air, reducing the load required for heating the incoming air. The image below (Figure 5) shows a typical winter example of a plate heat exchanger increasing the incoming cold air from -1°C to 15°C by taking heat indirectly from the warmer air extracted from the room. In the summer, the opposite occurs, with the incoming air stream likely to be of a higher temperature than the return air. These systems will significantly reduce the building's annual heating and cooling demand.

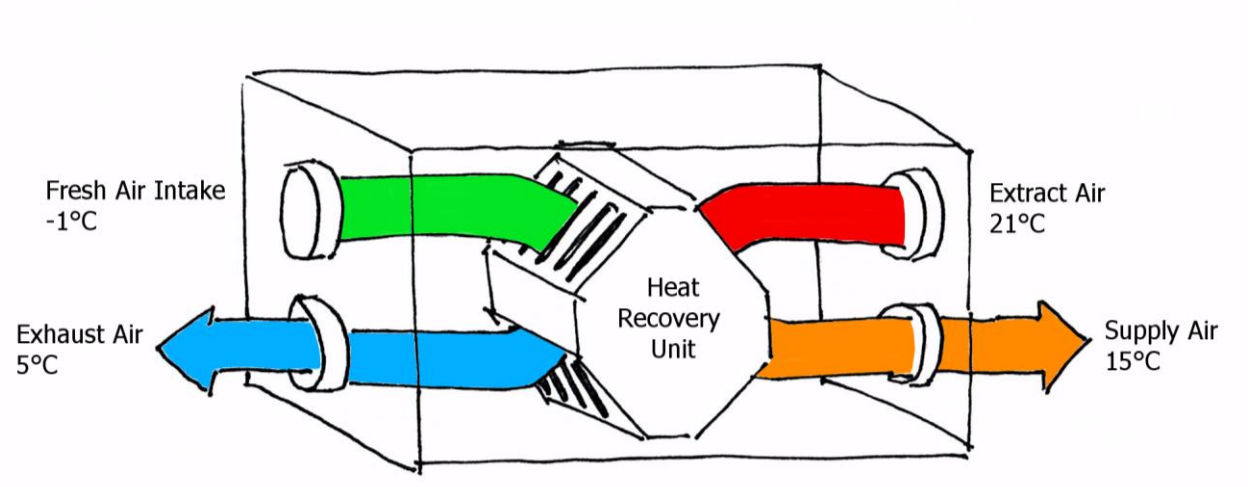


Figure 5 - Principles of a plate heat exchanger operating on a winters day

Various methods can be used for heat recovery with efficiencies of up to around 90%. These include plate heat exchangers, thermal wheels and run around coils. Thermal wheels and plate heat exchangers have been assumed to be used within the scheme for the purpose of the carbon emission calculations in this report.

Heating

All heating demand and low pressure hot water (LPHW) will be met by the low carbon district energy system, therefore negating the need for supplementary boilers in Building Q2. Further details on the district

energy system and the contribution it makes to the building's performance are provided in Section 4.4 of this report.

Medium temperature hot water provided by the district energy system will pass through heat exchanger within the upper ground floor west plantroom. Separate heating circuits for LPHW (<90°C) will be distributed throughout the building to serve the air handling plant systems, domestic hot water storage and space heating system.

Space heating will be provided using a combination of the following:

- Underfloor heating – assumed generally throughout the building in its permanentstate and in some circulation areas during the temporary phase as the CTC/fitness suite.
- Radiators – in offices and circulation spaces during the temporary phase.
- Warm air heaters – in the large CTC workshop space during the temporary phase and above entrance doors in both temporary and permanent states.
- Variable refrigerant flow (VRF) heating and cooling system – in the classrooms, small workshops and fitness suites during the temporary phase and also for the fitness suites and sports hall during the permanent state. The external VRF units will be located within an external open well above the main plantroom.

Control System

An intelligent Control System will be installed to monitor and report on the overall energy consumption of the building, and also to maintain a comfortable environment for the building occupants. The system will also monitor, among other parameters, temperatures, air and water flow rates, power consumption and flag up any faults within the building.

During temporary phase a limited version of the full system will be installed to run the CTC and fitness suite and provide the feedback necessary for these building uses. During the permanent sports fit-out the system will be upgraded to provide all the necessary requirements for this phase.

Metering of all mechanical and electrical systems will allow the management team to optimise the system to save energy and reduce running costs.

Lighting and electrical systems

All lighting shall meet the requirements set out in the CIBSE lighting guide LG4 and Sport England guidance.

LED or high-efficiency linear T5 fluorescent luminaires with high frequency dimmable control will be installed. This will reduce the overall energy consumption of the lighting and also minimise the heat gains to the space.

Controls to help reduce energy consumption will include PIR movement detectors and daylight dimming sensors. PIR sensors will generally be located in circulation and changing areas and will allow the lights to turn off during periods of inactivity. Daylight sensors will be used in areas such as fitness suites and the sports hall and will dim the lights when natural daylight meets the required lux levels.

High Efficiency Variable Speed Drives

Fans and pumps will be of variable speed for heating and ventilation systems to match building loads whilst maintaining maximum possible efficiency. A central Control System will control and optimise these speeds which will dramatically reduce energy consumption.

3.2 Condition 17 (B): Carbon Emissions

"The Environmental Sustainability Plan shall explain how the reduction in carbon emissions achieved through these building design and technology energy efficiency measures, compared with the emissions permitted under the national Building Regulations prevailing at the time the application for approval of reserved matters are submitted"

3.2.1 Building Regulations: Part L (2013)

In its permanent state, Building Q2 will be used as a sports hall and fitness suites. As such, it falls within the remit of Building Regulations Document L2A (ADL2A). A dynamic simulation model (DSM) software package, fully accredited for Level 5 Part L/EPC by the DCLG, has been used under the supervision of a licensed energy assessor (LCEA) to assess regulated carbon dioxide emissions for Building Q2. Appendix A of this Plan sets out the assumptions and methodology of the Target Emission Rate (TER)/Building Emission Rate (BER) calculations for the building in more detail.

The Building Regulations Part-L2 compliance method has been used as a basis for calculating a baseline model CO_2 emissions figure and subsequent improvements. The baseline model assumes Part L minimum set values for building fabric U-values, plant efficiencies, and operational parameters but does not assume connection to the KXC low-carbon district heating system (instead typical gas boilers have been assumed). The TER of this baseline model have been calculated as being 85.0 kg.CO_2/m^2 per year.

A 'Lean' model has been created taking into account improvements associated with passive design and energy efficiency measures only. This includes among other parameters improved U-values, improved air tightness, higher efficiency lighting and high efficiency ventilation systems with heat recovery – all based on the design for the building in its permanent state. The carbon emissions associated with this model were calculated as 80.1 kg.CO_2/m^2 per year. This is an improvement over the baseline model of just under 6%. The graph in Figure 6 below shows this improvement graphically against the baseline model's carbon emissions.

The KXC S106 Agreement targets each new building to achieve carbon emissions at least 5% lower than part L of the prevailing Building Regulations (i.e Building Regulations 2013) using good passive design and energy efficiency measures only such as those set out in Section 4.1. On the basis of these measures alone (i.e. disregarding the carbon savings that will be achieved by utilising the low carbon district energy system and any renewables), the building exceeds the target 5% reduction set by the S106 Agreement.

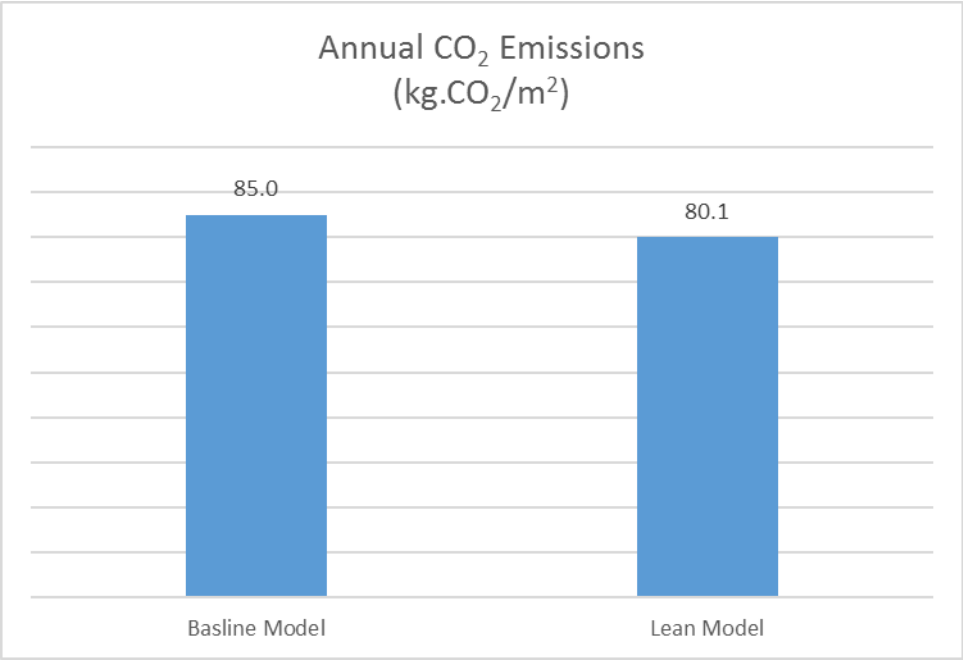


Figure 6 - Comparison of carbon emissions of baseline model and lean model

3.2.2 Business as Usual Benchmark (ECON 19)

The KXC Section 106 Agreement includes an obligation to carry out the development with the objective of achieving a site-wide 32% reduction in carbon emissions compared to the 'Business as Usual Benchmark', as identified in Appendix 2 of the Energy Assessment which supported the outline planning application (2005). For sports facilities, the relevant benchmark identified in the Energy Assessment is the 'Energy Consumption Guide 78'.

Since the completion of the Section 106 Agreement in 2006, Part L of the Building Regulations has been updated to include more stringent requirements in terms of the energy efficiency of a building and is now considered the primary method of assessment for a building's performance. By meeting the requirements of the current Part L (2013), the building will be achieving a reduction in carbon emissions that meets (and indeed exceeds), the Business as Usual Benchmarks set out in the original KXC Energy Assessment, thus making a contribution to the achievement of the 32% target set out in the Section 106 Agreement.

3.3 Condition 17 (C): Green Roofs

"The Environmental Sustainability Plan shall explain the specification for any green and/or brown roofs"

The Outline Planning Permission does not, within Parameter Plan KXC 021, define Plot Q2 as a priority location for green and/or brown roofs. Nonetheless, the possibility of a green roof was explored in the early concept design stages, both to provide some ecological enhancement to the site and an attractive outlook for overlooking buildings, in particular R7 and R8.

As noted in Section 3.1, Q2 sits directly above the Victorian Gasworks Tunnels which service the mainline into King's Cross Station and are generally less than 3m below ground level. The proximity of these tunnels impose significant loading constraints on the building which would be exacerbated by the additional weight created by a green roof, both in terms of its construction but also water retention in the soil/matting. During the design process, we have considered a range of engineering solutions to minimise the weight of the building and/or loading over the tunnels. However, the asset protection requirements are very stringent and we have been unable to find an acceptable solution which would support the building and the additional weight of a green roof. Consequently, Building Q2 does not include a green or brown roof.

3.4 Condition 17 (D): Reduction in Carbon Emissions

"The Environmental Sustainability Plan shall explain how energy shall be supplied to the building, highlighting:

i. How the building relates to the site-wide strategy for district heating incorporating tri-generation for distributed combined heat and power;

ii. How the building relates to the strategy for using biofuel boilers to supplement the energy supplied through district heating systems;

iii. The assessment of the cost-effectiveness and reliability of the supply chain for biofuels; and

iv. Any other measures to incorporate renewables"

3.4.1 Overview

The Energy Centre located in T1 building has already been constructed and is operational. The necessary heat and power distribution infrastructure is being installed across the site to enable the connection of each new building to the district energy system. The thermal energy thus supplied to Building Q2 will be used to provide all of its space heating and hot water demands. The combined heat and power (CHP) engines to be installed within the T1 Energy Centre also generates electrical power which is fed into the National Grid, thereby offsetting a significant percentage of the buildings' demand.

When fully fitted, the T1 Energy Centre will include the following principal items:

- 3 No. 2 MWth gas fired CHP
- 2 No. thermal stores (75m^3 each), integral to the CHP operating hours strategy
- 3 No. 10 MWth gas boilers

These items are being installed on a phased basis to meet the peak heat demands and optimise efficiency. At this time, only one gas fired CHP remains to be installed. This is expected to take place by 2019.

KCCLP and its partners have established the Energy Services Company (ESCo) to run the district heating system.

As outlined in previously submitted (and approved) Environmental Sustainability Plans, the position regarding the inclusion of biomass continues to be actively monitored by KCCLP. However, at this time, a robust commercial case to support biomass cannot yet be made. In particular, there remain concerns on air and fuel quality, particularly as the KXC site (together with the vast majority of London), is situated within an Air Quality Management Area. NOx levels are already high in this area and this is expected to be exacerbated in the King's Cross locality by biomass emissions and increased lorry movements to deliver the fuel. There are also concerns regarding supply, with expected limitations on biomass growth in the UK (driven, for example, by air quality) affecting the harvesting rates and potentially increasing the cost of fuel. Large amounts of biomass would also need to be delivered and stored, as the burning of biomass is not as efficient as fossil fuels via CHP.

The carbon emission calculations used within this report have assumed that, in total, 65% of the thermal energy used across the KXC site will be produced by CHP with the remainder provided by gas-fired boilers.

3.4.2 CO_2 Savings Arising From KXC Energy Centre

Taking into account the passive design and energy efficiency measures set out in Section 3.1 of this plan, combined with the contribution made by the connection of Building Q2 to the low carbon district energy system, the carbon emissions for the building (in its permanent state), BER, are reduced further to 34.0 kg.CO_2/year. When compared to the baseline model set out in Section 3.2 this 'Lean with District Heating Model' represents an overall reduction of 60% in carbon emissions. This graph is shown in Figure 7 below.

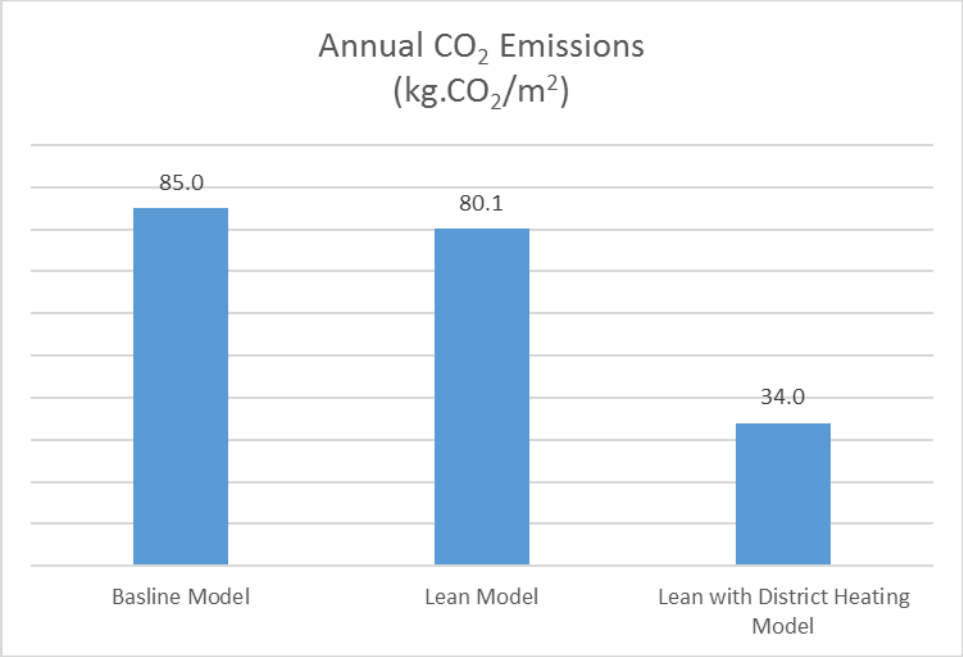


Figure 7 - Comparison between carbon emissions for Baseline Model, Lean Model and the Lean Model with District Heating Model

3.4.3 Renewables

The September 2005 Energy Assessment and Parameter Plan KXC021 do not highlight Q2 as a location where wind turbines or photovoltaic (PV) panels are specifically required. Nevertheless, various forms of renewable technology on Building Q2 were considered during the design process, including the preferred on-site renewable technologies (PVs, wind turbines, solar water heating and ground source (bore hole) cooling) described in the 2005 Energy Assessment. In summary, the review, by technology, had the following outcomes:

- Photovoltaic Panels – The proposed shape of the roof pitch is such that PVs would be west-facing, meaning that for most of day, up until the evening, the angle of the panels would be far from ideal. This roof pitch is an inherent part of the architectural design of the building, providing and dramatic profile on the prominent north façade in the views along York Way. In any event, the surrounding buildings Q1, R7 and R8 are all taller than Q2 and would dramatically reduce the amount of direct sun which would hit the panels. This would have a significant overall impact on the efficiency and performance of the panels. The extra load created by the panels on the roof would also have a structural impact on the tunnels located below the building.

- Wind turbines – Though outside the priority zone for wind turbines set by parameter Plan KXC021, the feasibility of the application of wind turbines to the buildings was assessed. The loading restrictions of the site are very finely balanced and are not sufficient to be able to accommodate the extra weight of wind turbines and the building. Additionally, due to the low height of the building wind speeds would be reduced by the surrounding, taller buildings.

- Solar hot water – Although domestic hot water demand for a sports hall building is fairly well-suited to solar hot water the extra weight and plant space required for this technology limits its use in this scenario. As for the photovoltaic panels and the wind turbines, the extra weight of the roof-mounted panels and the buffer tanks, in addition to the proposed building would be too great for the Gaswork Tunnels. Plant space within the building is also extremely limited and so extra tanks would impact on the accessibility in the plantrooms and the provision of core facilities/back of house functions. Finally, the west-facing pitches of the roof would mean that for most of the day the angle of the panels would be far from ideal and once the sun moves around to the west, the larger buildings R7 and R8 would obstruct the direct sun from hitting the panels.

- Ground source heat pumps – Ground source heat pumps ('GSHP') require pipes to be buried beneath the ground, adjacent to the building. With asset protection requirements limiting

underground structures in close proximity of the Gasworks Tunnels, there is no scope to position pipes within the footprints of the building or to the depths required.

3.5 Condition 17 (E): BREEAM

"The Environmental Sustainability Plan shall explain how the proposed building has been designed to achieve a BREEAM and/or Ecohomes rating of "very good" (or an equivalent assessment method and rating) or better"

3.5.1 Overview

BREEAM is a recognised methodology to drive improvement in the sustainability performance of buildings. The standards set by BREEAM are being used to maximise the effectiveness of the issue-specific strategies, including energy, water and waste, addressed in this Plan. The project team is fully committed to go beyond the requirement of the condition for 'Very Good' rating and are actively targeting an 'Excellent' rating under the BREEAM UK New Construction 2014 Shell and Core assessment for Leisure Centre and Sports Hall.

The team has taken a holistic approach to every aspect of the buildings' design utilising passive and active design methodologies to ensure a truly sustainable building is produced. The key design features covering energy, water and resource efficiencies, together with supplier and construction management and commissioning practice, all discussed in other sections of this Plan, fully embrace sustainability best practice and will contribute to delivering a high BREEAM rating.

The full list of credits which are being targeted can be seen within the 'pre-assessment' report in Appendix B, but are also summarised in Figures 8 and 9 illustrating the pre-assessment overview following this section. At this stage, the pre-assessment predicts an overall score of 79.8%, equating to an 'Excellent' rating. However, it also identifies additional credits which could result in a higher potential score of 85.5%, greater than the 85% required for the achievement of an 'Outstanding' rating.

It should be noted that the pre-assessment is provisional on the basis that all of the documentary evidence required for a formal assessment (in the form of tender documents and drawings etc) is not yet available at this planning stage. Full evidence will be gathered in due course at the detailed design stages as the projects progress.

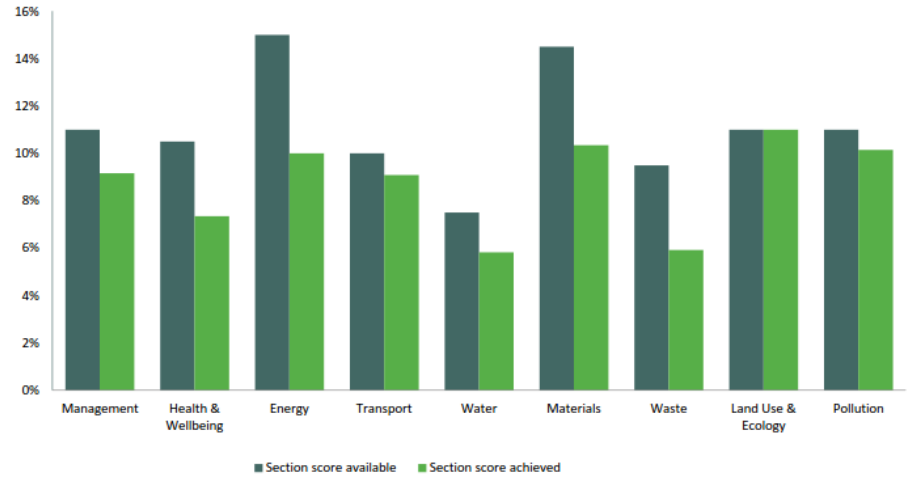
BREEAM UK New Construction 2014 Pre-Assessment Estimator: Indicative Rating & Building Performance

BREEAM® UKI

Overall Building Performance

Building name	Building Q2
Indicative BREEAM rating	Excellent
Indicative Total Score	79.8%
Min. standards level achieved	Outstanding level

Building Performance by Environment Section



Environmental Section	No. credits available	Indicative no. credits Achieved	% credits achieved	Section Weighting	Indicative Section Score
Management	18	15	83.33%	11.00%	9.16%
Health & Wellbeing	10	7	70.00%	10.50%	7.35%
Energy	21	14	66.67%	15.00%	10.00%
Transport	11	10	90.91%	10.00%	9.09%
Water	9	7	77.78%	7.50%	5.83%
Materials	14	10	71.43%	14.50%	10.35%
Waste	8	5	62.50%	9.50%	5.93%
Land Use & Ecology	10	10	100.00%	11.00%	11.00%
Pollution	13	12	92.31%	11.00%	10.15%
Innovation	10	1	10.00%	N/A	1

Figure 8 - Pre-assessment overview of Building Q2 indicating 'Excellent' rating under BREEAM New Construction 2014 for Leisure

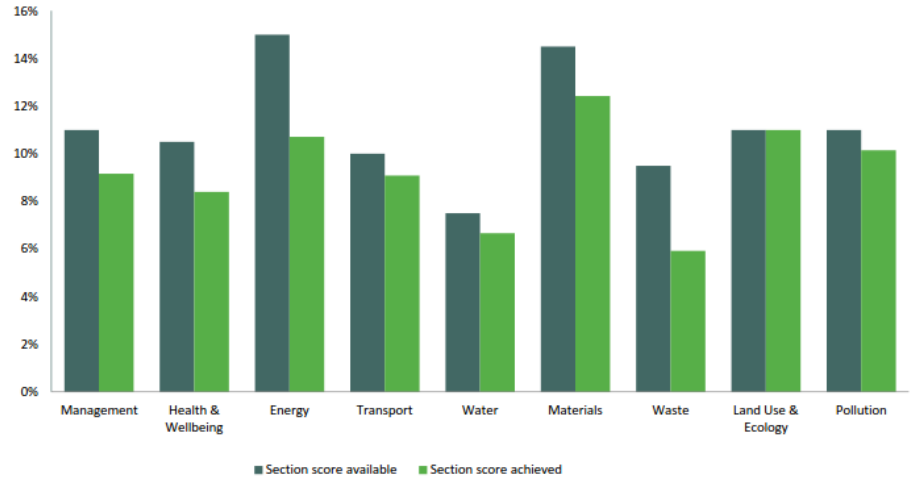
BREEAM UK New Construction 2014 Pre-Assessment Estimator: Indicative Rating & Building Performance

BREEAM® UKI

Overall Building Performance

Building name	Building Q2
Indicative BREEAM rating	Outstanding
Indicative Total Score	85.5%
Min. standards level achieved	Outstanding level

Building Performance by Environment Section



Environmental Section	No. credits available	Indicative no. credits Achieved	% credits achieved	Section Weighting	Indicative Section Score
Management	18	15	83.33%	11.00%	9.16%
Health & Wellbeing	10	8	80.00%	10.50%	8.40%
Energy	21	15	71.43%	15.00%	10.71%
Transport	11	10	90.91%	10.00%	9.09%
Water	9	8	88.89%	7.50%	6.66%
Materials	14	12	85.71%	14.50%	12.42%
Waste	8	5	62.50%	9.50%	5.93%
Land Use & Ecology	10	10	100.00%	11.00%	11.00%
Pollution	13	12	92.31%	11.00%	10.15%
Innovation	10	2	20.00%	N/A	2

Figure 9 - Pre-assessment overview of Building Q2 indicating a potential 'Outstanding' rating under BREEAM New Construction 2014 for Leisure

3.6 Condition 17 (F): Wildlife

"The Environmental Sustainability Plan shall explain the incorporation of bird boxes, bat roosts and other wildlife features on buildings"

3.6.1 Overview

As noted in Section 3.3, Plot Q2 is not identified on Parameter Plan KCX 021 as a location for green or brown roofs. Although green and brown roofs were considering early in the design process, the technical constraints relating to loading above the Gaswork Tunnels could not be overcome and therefore such roofs do not feature in the proposed design.

Instead, Plot Q2 will focus on providing opportunities for ecological enhancement and increased biodiversity by means of providing new nesting and roosting areas for bat and birds.

A number of protected species have been recorded on the wider KXC site. These species include;

- foraging and commuting common pipistrelle bats;
- nesting and foraging black redstarts;
- nesting and foraging house sparrows; and
- commuting peregrine falcons.

None of these protected species have been recorded on Plot Q2 to date, however they have been recorded in the area immediately adjacent to the site.

The bird and bat enhancement will be incorporated during the construction of the building to provide new habitats for wildlife known to use the wider KXC site. The specification and precise location of these boxes will be decided in liaison with the project's ecologist and architects to ensure they respond to species found in the area and are installed in suitable positions. However, the general approach to siting and type is set out in the paragraphs below.

3.6.2 Bat boxes, tubes & bricks

Simple bat boxes will be incorporated or attached to the new build to provide roosting opportunities for bats. Bat boxes and/or tubes/bricks will be placed as high as possible in sheltered or wind- free areas exposed to the sun for several hours per day. They will not be placed near street lighting or in area where light could be emitted from office windows etc. Boxes will be sited on south east to south west elevations.

3.6.3 Bird boxes

Built-in bird boxes or external bird boxes will be considered on the building to provide additional nesting areas for the birds currently utilising the wider King's Cross site. Nest boxes of varying kinds will be considered which are suitable for different bird species including some of the protected species above. 'Open' boxes for starlings and sparrows, along with 'closed' boxes for tit species will be considered, these could be affixed to the new building. Nest boxes are a very effective but simple enhancement measure. Bird boxes will be mounted facing between south-east and north, to avoid strong direct sunlight and the heaviest rain.

3.6.4 Lighting

External lighting will be designed to be sympathetic to nocturnal wildlife known to use the wider King's Cross site, namely foraging and commuting bats.

3.7 Condition 45: Drainage

"The new drainage infrastructure within the site shall be designed to achieve a combined (storm and foul) peak discharge to the existing combined sewers of 2292l/s or less"

3.7.1 Site Wide Drainage Infrastructure

The figure of 2292 l/s in the wording to Condition 45 describes the maximum peak (storm and foul) discharge which is permissible for the site as a whole to discharge to the existing combined sewers. The peak discharge will be split between the Camden Sewer and York Way Sewer (for Northern Area) and the Camley Sewer / Fleet Sewer (for the Southern Area).

The cumulative peak discharge from the many building plots and areas of infrastructure will exceed 2292 l/s under certain weather conditions. In these instances, the site wide drainage infrastructure, including online and offline attenuation (see below), will attenuate peak flows discharging from individual plots, adopted highway and public realm, enabling cumulative peak flows to be reduced to 2292 l/s or less.

The site wide surface and foul water disposal strategy can be summarised as follows:

- To provide separate surface and foul water networks, combining only at the final manhole prior to connection into the existing Thames Water sewerage network
- To provide online attenuation (for example oversized pipe work) and offline attenuation (for example proprietary modular underground storage systems / tanks) to buffer peak flows generated within the site down to the agreed discharge rates into the existing Thames Water sewerage network;
- To ensure that no above ground flooding occurs during the worst case 1 in 30 year storm event;
- To ensure that no internal building flooding occurs during the worst case 1 in 100 year (+20%) storm event;
- To accord with Sewers For Adoption 6th Edition;
- To discharge at various locations into the sewerage network; and
- To design the above infrastructure such that combined surface and foul water flows do not exceed 2292 l/s during a 1 in 30 storm event.

The site wide drainage infrastructure at King's Cross Central can be described in terms of three drainage infrastructure areas, incorporating both building plots and infrastructure/public realm. These are described in the Table 1 below

Drainage Infrastructure Area		
	Plot developments	**Infrastructure / Public Realm**
Eastern Goods Yard	The Granary Complex, Q1, Q2, R1, R3, R4, R5, R7 & 8, S1, S2, T1, T2, J1, H1, K1, K2, K3, K4 and 50% of I1)	Transit Street, Wharf Road, Goods Street, Granary Square, Cubitt Park and Handyside Park
Southern Area Infrastructure	A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, B6, D1, D2, F1 and V1	The Boulevard, Goods Way, Station Square and Pancras Square
Remainder of the Northern Area including the Triangle Site	M1, M2, N1, N2, P1, P2, S3, S4, S5, T3, T4, T5, T6 and W1	Canal Street and Cubitt Square

Table 1 - Drainage Infrastructure Areas

Table 2 identifies the assumed peak foul and surface water flows from each of the building plots which underpin the design of the site-wide infrastructure. The foul water figures are based on CIRIA 177 Variable Peaking Factor and the assumed foul water discharges from various land uses identified in Table 3. The surface water peak flows are based on a 1 in 30 year storm. It should be noted that it is most unlikely that the foul and surface water peak discharges from each individual plot will coincide with each other.

Generally, foul water discharges represent small but consistent flows subject to diurnal patterns. For

example, residential properties will exhibit two peaks within their diurnal flow pattern, one in the morning and one in the early evening.

Surface water discharges, on the other hand exhibit extreme variations in flow, directly related to rainfall intensity.

The surface water discharge from each plot development will have its own unique hydrograph (identifying the variation between flow and time – the peak of which only lasting for a few minutes in most cases). Each one of these peaks (within the hydrographs) combine within the main drainage infrastructure at different points in time during the storm event creating an averaged flow within the pipe network.

These flows will discharge into the Thames Water network via flow hydraulic controls at the downstream end of each network. These hydraulic controls limit the discharges to a combined maximum of 2292l/s. Where the plot development discharges combine to produce flows in excess of the maximum allowable discharge, water will be held within the drainage infrastructure which has been specifically sized to accommodate these flows.

	Assumed Peak Flows (l/s)	
Plot reference	**Surface Water (1 in 30 year event)**	**Foul Water**
Eastern Goods Yard		
G1	25	1.1
H1	15	0.9
J1	147	4.2
K1	24	1.2
K2	101	0
K3	150	6
K4	117	1.8
L1 - L7	1105	25.2
Q1 & Q2	191	6
R1	57	11.8
R7 &8	257	12.8
R3	128	4.6
R4	127	3.5
R5 (North & South)	173	5.3
S1	158	11.9
S2	162	12.7
T1	192	2.1
T2	162	10.2
I1	25	1.2
N2	84	0
Totals	**3400**	**123.8**

Table 2 - Assumed peak foul and surface water flow rates from each KXC plot

Land Use	Demand Options	Discharge to Sewer (l/day/hd)	l/s/head	Operational Hours	Population Density (m² per person)
Residential	-	152	0.0023457	18	36.2
Student Accommodation	-	152	0.0023457	18	19.5
Retail	Large Retail	26.6	0.0009236	8	40
Food/Drink	Customer/day 2hr sittings	28.5	0.0009896	8	1.4
Education	General	19	0.0006597	8	10
Business	Without Canteen	41	0.0014236	8	12
Hotel		133	0.0046181	8	20
Leisure	Sports club	142.5	0.0049479	8	40

Table 3 - Assumed foul water discharges by land use

3.7.2 Drainage Infrastructure

Plot Q2 is serviced by the Eastern Goods Yard drainage systems (Table 1), and discharges via a restricted discharge in to the combined Thames Water Camden Sewer. The drainage networks have been designed on SUDS principles providing an overall peak flow reduction of 10% (based on a 1 in 30 year storm).

Thames Water has approved the surface water discharge into the Camden Sewer for the network serving Plot Q2. For the purposes of the hydraulic model and subsequent attenuation design, Buildings Q1 and Q2 have been assessed as a single plot. With approved surface water discharge peak flows of 191 l/s and 6 l/s for surface water and foul water, respectively. The plots have also been assessed individually with flow rates for Q2 of 94.4l/s for surface water and 1.1l/s for foul water.
It should be noted that the figures in Table 2 do not specifically include public realm areas. However, the Eastern Goods Yard Area public realm was included in the hydraulic model used during the design of the infrastructure to ensure that each of the drainage sub catchments (buildings and public realm) are attenuated and the flows into the combined Camden are restricted so that the permissible discharges set out in the Outline Planning Permission are not exceeded.

Drawing 20227-007-500-04 (Figure 10 below) shows the surface water sewer network serving Plot Q2 and the associated catchment area. The network has been installed and is live. The adopting drainage authority (IWNL) has approved the design and installation cognisant of the requirements under Condition 45 of the Outline Planning Permission. Flows within the network are controlled via a hydrobrake unit in Stable Street to ensure that the agreed discharge to the Camden Sewer is not exceeded.

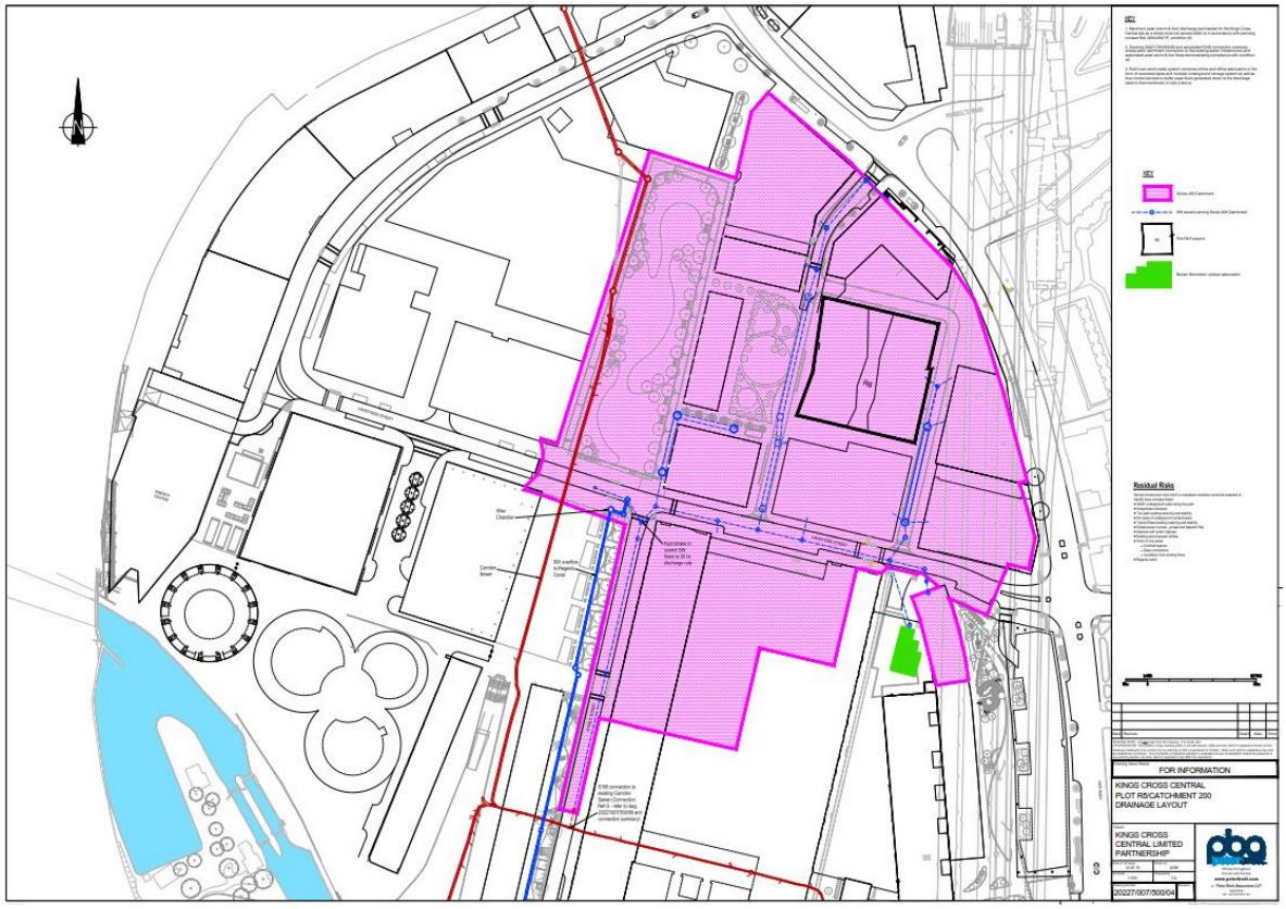


Figure 10 - Plan showing extent of the Eastern Goods Yard drainage infrastructure area

4 Response to Section 106 Agreement Obligations

4.1 Section AA: Environmental Sustainability – Water

Section AA of the Section 106 agreement places an obligation to use reasonable endeavours:

- *To incorporate within the detailed design water efficiency measures such that the design secures at least 40% of the potable water consumption credits available under the BREEAM methodology which represents a reduction of approximately 20-30% against typical water consumption.*

- *To incorporate one or more of groundwater abstraction, grey-water and black-water recycling and rainwater harvesting as alternative water supplies to meet 5% or more of the non-potable water needs.*

- *To ensure that the design for the treatment of storm water run-off incorporates, where practicable, filtration, attenuation and other techniques that is consistent with current best practice on SUDS, to control the timing and volume of flows.*

4.1.1 Water Efficiency

Building Q2 will achieve very high standards of water efficiency through the use of internal water efficiency design. The design teams have used the BREEAM criteria as their benchmark in driving down potable water consumption for Building Q2.

The BREEAM assessment targets a minimum of 3 credits under Water 01 – Water Consumption issue, which means at least a 40% reduction in potable water consumption compared to BREEAM's baseline in accordance with the requirements of Section AA of the Section 106 Agreement. Water efficiency measures will include 'auto shut-off' facilities on all toilet supplies and dual flush WCs.

The table below outlines the BREEAM compliant water efficient appliances and fittings proposed for the project at the shell and core stage. The occupier will be expected to meet these targets to the extent they are responsible for fit-out of appliances:

Water Consumption	Target	Note
WCs toilets	2.95L	Dual flush 4L full and 2.6L
Urinals	0.5L	Full flush - automatic
Wash hand basin taps	4L/min	
Showers	4L/min	

4.1.2 Alternative Water Supplies

As already mentioned in this report, the plot where Building Q2 is situated has loading constraints due to the Gasworks Tunnels running below the site. For this reason, the building is designed to be as lightweight as possible and without a basement level. It is considered that the storage and plant associated with rainwater collection or grey water harvesting systems would place an unacceptable additional load on the tunnels and are therefore not feasible in this location. Further, the building works hard to accommodate the necessary sports related and back of house functions within the plot boundary. Notwithstanding the loading constraints for the building, there is no available space which could be used to incorporate such systems.

4.1.3 Sustainable Urban Drainage

Surface water drainage methods that take account of quantity, quality and amenity issues are collectively referred to as Sustainable Urban Drainage Systems ('SUDS'). These systems provide a natural approach to managing drainage by lowering flow rates, increasing water storage capacity and reducing the transport of

pollution to the water environment. SUDS aim to reduce surface water flooding, improve water quality and enhance the amenity and biodiversity value of the environment and are thus considered to be more sustainable than conventional methods. Typical SUDS techniques include the use of:

- Green/brown roofs
- permeable surfaces
- infiltration trenches filter drains and filter strips
- swales - shallow drainage channels
- detention basins, purpose built ponds and wetlands

Not all of these systems are suited to dense urban environments such as King's Cross. However, the sitewide drainage and attenuation strategy (explained in Section 3.7) has been designed holistically on SUDS principles and additional opportunities for incorporating SUDS are considered on a plot-by-plot basis, usually through soft landscaping and/or the provision of green/brown roofs.

In this case, the Reserved Matters submission for Q2 includes only a limited area of public realm, extending to the adjacent street and footpath (Wilberforce Street), a small part of the pavement along York Way and a courtyard adjacent to the entrance to Rubicon Court (R4). Save for the planted beds in the R4 courtyard which will provide some attenuation to storm water run-off, the proposed public realm is largely hard landscaped. Further, there is no scope for green or brown roofs or terraces due to loading constraints associated with the Gasworks Tunnels below the site (see Section 3.2).

4.2 Section Y: Construction materials and waste

As Section Y of the S.106 Agreement imposes obligations to:

- *Implement the Construction Materials and Purchasing Strategy.*
- *Apply the Construction Materials and Purchasing Strategy to agreeing specifications and targets in contracts with contractors, designers and suppliers of services in relation to construction.*
- *To use reasonable endeavours:*
    - *To minimise packaging waste associated with the delivery of construction materials.*
    - *To produce topsoil and subsoil that uses subsoil and crushed rubble from the site combined with organic material for use in areas of landscaping.*
    - *To achieve the Construction Targets.*

4.2.1 Construction Materials and Purchasing Strategy

The project team intends that best practice will be followed and surpassed wherever practicable, in order to maximise resource efficiency. The Construction Materials and Purchasing Strategy referenced in Section Y of the Section 106 Agreement will be adopted, while careful planning and effective control will ensure that waste during the construction phase is minimised.

4.2.2 Packaging Waste

Packaging used to protect construction materials and assemblies in transportation will be kept to a minimum and wherever possible returned to be re-used.

4.2.3 Soil

Plot Q2 currently comprises the temporary MUGA and a construction logistics site. There is no top soil to be removed and re-instated. The submitted Earthworks and Remediation Plan which forms part of this Reserved Matters submission addresses the nature and quantity of arisings from construction of the building and associated public realm, and the arrangements for their re-use and disposal.

Due to the brownfield nature of the KXC site, there are no natural topsoil or subsoil resources on-site. A Topsoil Manufacture Feasibility Study has been undertaken by Tim O'Hare Associates to assess the suitability of site-won clay fill from the KXC site as a constituent of manufactured topsoil, rather than importing material onto the site for landscaping use. Due to the density, plasticity and poor drainage qualities associated with clay fill, the study concludes that manufactured topsoil derived from this material would not be suitable for use in permanent landscaping schemes such as the planted beds in the R4 Courtyard or tree-pits. As such, it is recommended that imported organic material is used in these areas.

4.2.4 Construction Targets

A BREEAM rating of 'Excellent' will be the principal driver for the team's endeavours to achieve the best possible performance against the Construction Targets. BREEAM credits cover the Green Guide rating of the major building elements, the provision of floor coverings, the environmental impacts of paints and varnishes, the responsible sourcing of materials and the global warming potential of insulants, all matters addressed by the Construction Targets.

At this early stage the exact degree to which all the Construction Targets will be achieved cannot yet be determined, because the precise specifications and quantities of many of the materials have not yet been finalised. It has already been confirmed that all timber products within Zone Q, and also the temporary timbers used for site works during the buildings use as a CTC, will be sustainably-sourced through an auditable supply chain and that ozone-depleting substances will not be used.

4.3 Section Z: Waste

Section Z of the S.106 Agreement imposes obligations to:

- *Provide occupiers with Waste Information Packs and use reasonable endeavours to obtain feedback on the success or popularity of the initiatives contained within the Packs.*
- *Use reasonable endeavours to incorporate within the detailed design best practice design solutions that provide for waste segregation and storage areas and to maintain the solutions that are implemented.*
- *Provide and maintain segregated waste containers within the Public Realm areas at suitable locations and in appropriate numbers.*

4.3.1 Waste Information Packs

To encourage the minimisation of waste generated during the operational life of the building, Waste Information Packs will be provided to the occupier(s), and arrangements will be made to monitor their effectiveness in encouraging waste minimisation.

4.3.2 Design Solutions

Dedicated and sufficient facilities will be provided for the separation, storage and easy handling of waste, included separate bins for recyclable and non-recyclable materials. The location of the bin storage facing Wilberforce Street allows convenient access to where collections will be made. The desire to achieve an 'Excellent' or the aspiration target of an 'Outstanding' BREEAM rating for the building will ensure that current best practice is followed. Please refer to the Refuse Strategy set out in the submitted Urban Design Report for further details.

5 Appendix A – Part L2 Analysis

5.1 Overview

The content of this Appendix is governed by the Building Regulations Part-L2, 2013. The Appendix focuses on three of the five criteria (Criteria 1, 2 and 3) required for compliance at the design stage. Criteria 4 and 5 have not been addressed because the project team have committed to adhering to the best practice guidelines with respect to BREEAM. A 'Building Log Book' and 'User Guide' will be provided, thereby satisfying Criterion 5 in any event. In addition, Criterion 4 covering quality of construction and commissioning will be satisfied as the Contractor will commit to achieving best practice certification under the 'Considerate Constructors Scheme'.

Criterion 1
Target CO_2 emissions rate (TER), requires that the Building CO_2 Emissions Rate (BER) is equal or less than the TER when using pre-determined scenarios and weather data.

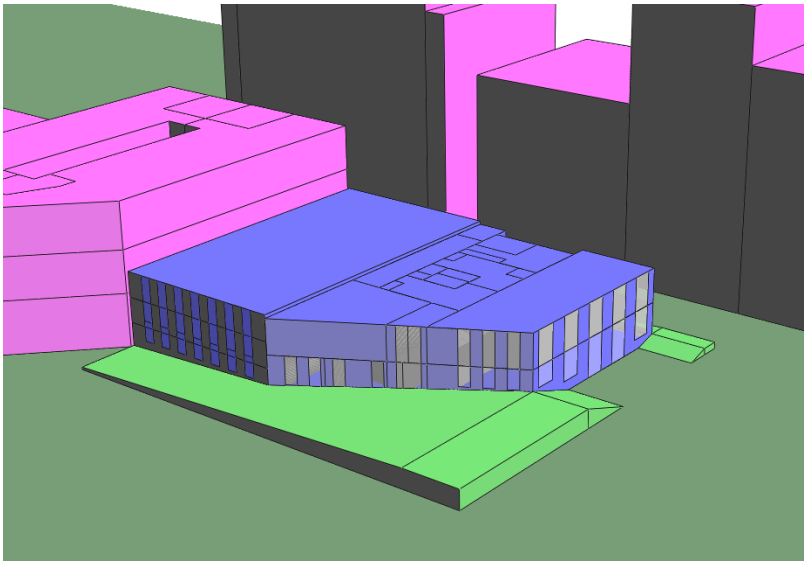
Criterion 2
Limits to design flexibility ensure that a minimum level of performance is achieved for the fabric, heating, ventilation and air conditioning (HVAC) systems, and lighting for all buildings and designs.

Criterion 3
Limits to solar gains, assessment to highlight compliance with a reference mean solar gain figure determined through April to September onto an 'East' facing façade with fixed glazing dimensions and solar performance. All facades on Building Q2 will need to adhere to the equivalent or less mean solar gain figure predetermined.

The building's preliminary Part L2 calculations have been carried out by E3 using IES-VE dynamic modelling software. IES complies with the requirements of the Chartered Institution of Building Services Engineers (CIBSE) AM11 as required by BREEAM.
A full three-dimensional thermal model for the building was created in IES from the architects drawings.
Numerous simulations were run to optimise the energy demand and heating and cooling power, by studying various options for the design of the façade, glazing type, the level of thermal insulation in the fabric, the level of thermal mass, etc. Then the type of local and central system was modelled to identify the system with lowest energy consumption.

5.2 Building Conditions

The 3D geometry and building construction materials have been modelled based on the architectural plans and elevations. This model describes the orientation, geometry of building form and all associated exposure of surfaces, material constructions and glazing layouts.



5.3 Operation Parameters

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 defines these loads.

Each of the NCM Operational Templates applies a fixed set of characteristics including:

- Operational hours and profile
- Occupancy densities and loads
- Minimum ventilation rates
- Small power loads
- Room conditions
- Domestic hot water loads

Solar loads vary daily and depend on seasonal and weather conditions, and will affect loads which are accounted for in the thermal modelling process, such as solar transmission, conduction and building heat transfer. These are represented in the model by virtue of the weather data file.

5.4 Criterion 1 – Target Emission Rate

Target CO2 emissions rate (TER), requires that the Building CO2 Emissions Rate (BER) is equal or less than the TER when using pre-determined scenarios and weather data.

Carbon savings were calculated using the industry-approved software IES-VE.

The carbon emissions of a notional building without district heating were calculated based upon the building operating as an air conditioned building year round. The calculations have assumed the benefits of daylight dimming. The final BER (including all passive design and energy efficient measures, as well as district heating) was calculated to be significantly lower than the associated TER. Based on this Building Q2 complies with Criterion 1 of the Building Regulations.

5.5 Criterion 2 – Limits to Design Flexibility

Limits to design flexibility ensure that a minimum level of performance is achieved for fabric, heating, ventilation and air conditioning (HVAC) systems, and lighting for all buildings and designs.

All fabric, fittings, HVAC systems and lighting have been specified with performance better than or equal to the Part-L2 requirements. Building Q2 therefore complies with Criterion 2 of the Building Regulations.

5.6 Criterion 3 – Limits to Solar Gain

Limits to solar gains, assessment to highlight compliance with a reference mean solar gain figure determined through April to September onto an 'East' facing façade with fixed glazing dimensions and solar performance. All facades on Building Q2 will need to adhere to the equivalent or less mean solar gain figure predetermined.

The reference façade is that of a 1m high piece of glazing across the full width of the occupied space. A frame taking up 10% of this window area should also be assumed. The glazing solar performance (g-value) is 0.68. The façade is East facing. Hence, the solar performance of any façade make-up on any orientation of Building Q2 will have to better the mean solar gain figure passing into the occupied area set by this reference façade system.

All of the Building Q2 facades show the resulting mean solar gain to be less than the reference glazing system figure.

Building Q2 therefore satisfies Criterion 3 of the Building Regulations Part-L2.

6 Appendix B – BREEAM Pre-Assessment Report

6.1 Introduction

Sweco have prepared this document to highlight the credits which have been sought in order for the Kings Cross Central Zone Q Building Q2 development to achieve an ***'Excellent'*** rating, with aspiration to Outstanding, under BREEAM UK New Construction 2014 Shell & Core for Other Buildings (Type 2): Assembly and Leisure.
The final BREEAM certification report will be produced in-line with the credits highlighted within this schedule and sent to the Building Research Establishment (BRE) for quality assurance checking and accreditation.

6.2 Predicted Assessment

This section highlights the targeted credits of each BREEAM category for Shell & Core assessment of the Sports Hall at zone Q.

6.2.1 Management

Management	Credits Breakdown	Available Credits	Targeted Credits
Man 01 Project brief and design		**4**	**4**
	Stakeholder Consultation (project delivery)	1	1
	Stakeholder Consultation (third party)	1	1
	Sustainability Champion (design)	1	1
	Sustainability Champion (monitoring progress)	1	1
Man 02 Life cycle cost and service life planning		**4**	**1**
	Elemental life cycle cost (LCC)	2	0
	Component level LCC	1	0
	Capital cost reporting	1	1
Man 03 Responsible construction practices		**6**	**6**
	Pre-Requisite: Timber used on site		
	Environmental Management	1	1
	Sustainability Champion - Construction	1	1
	Considerate Construction	2	2
	Monitoring of Construction Site Impacts - Utility Consumption	1	1
	Monitoring of Construction Site Impacts - Transport of Construction Materials & Waste	1	1
Man 04 Commisioning and handover		**4**	**4**
	Commissioning & Testing Schedule & Responsibilities	1	1
	Commissioning Building Services	1	1
	Testing & Inspecting Building Fabric	1	1
	Handover	1	1
Man 05 Aftercare		n/a	

6.2.2 Health and Wellbeing

Health & Wellbeing	Credits Breakdown	Available Credits	Targeted Credits
Hea 01 Visual Comfort		**3**	**1**
	Daylighting	1	0
	View Out	1	0
	Internal and external lighting levels, zoning and control	1	1
Hea 02 Indoor Air Quality		**2**	**1**
	Ventilation	1	0
	Potential for natural ventilation	1	1
Hea 03 Safe containment in laboratories		n/a	
Hea 04 Thermal comfort		**2**	**2**
	Thermal modelling	1	1
	Adaptability - for a projected climate change scenario	1	1
Hea 05 Acoustic Performance		**1**	**1**
	Acoustic performance standards	1	1
Hea 06 Safety and Security		**2**	**2**
	Safe Access	1	1
	Security of site and building	1	1

6.2.3 Energy

Energy	Credits Breakdown	Available Credits	Targeted Credits
Ene 01 Reduction of energy use and carbon emissions		**12**	**9**
	Energy performance	12	9
Ene 02 Energy monitoring		**2**	**2**
	Sub-metering of major energy consuming systems	1	1
	Sub-metering of high energy load and tenancy areas	1	1
Ene 03 External lighting		**1**	**1**
Ene 04 Low carbon design		**3**	**2**
	Passive design analysis	1	1
	Free cooling	1	0
	Low and zero carbon technologies	1	1
Ene 05 Energy efficient cold storage		n/a	
Ene 06 Energy efficient transportation systems		**3**	**0**
	Energy consumption	1	0
	Energy efficient features	2	0
Ene 07 Energy efficient laboratory systems		n/a	
Ene 08 Energy efficient equipment		n/a	
Ene 09 Drying space		n/a	

6.2.4 Transport

Transport	Credits Breakdown	Available Credits	Targeted Credits
Tra 01 Public Transport Accessibility		**5**	**5**
Tra 02 Proximity to Amenities		**1**	**1**
Tra 03 Cyclist facilities		**2**	**1**
	Cycle storage	1	1
	Cyclist facilties	1	0
Tra 04 Maximum Car Parking Capacity		**2**	**2**
Tra 05 Travel Plan		**1**	**1**

6.2.5 Water

Water	Credits Breakdown	Available Credits	Targeted Credits
Wat 01 Water Consumption		**5**	**3**
Wat 02 Water Monitoring		**1**	**1**
Wat 03 Water Leak Detection and Prevention		**2**	**2**
	Leak detection system	1	1
	Flow control devices	1	1
Wat 04 Water Efficient Equipment		**1**	**1**

6.2.6 Materials

Materials	Credits Breakdown	Available Credits	Targeted Credits
Mat 01 Life Cycle Impacts		**6**	**4**
Mat 02 Hard Landscaping and Boundary Protection		**1**	**0**
Mat 03 Responsible Sourcing		**4**	**3**
	Pre-requisite: Timber procurement details		
	Sustainable Procurement Plan	1	1
	Responsible Sourcing of Materials	3	2
Mat 04 Insulation		**1**	**1**
Mat 05 Designing for durability and resilience		**1**	**1**
Mat 06 Material efficiency		**1**	**1**

6.2.7 Waste

Waste	Credits Breakdown	Available Credits	Targeted Credits
Wst 01 Construction Waste Management		**4**	**2**
	Construction Resource Efficiency	3	1
	Diversion of Resources from Landfill	1	1
Wst 02 Recycled Aggregates		**1**	**0**
Wst 03 Operational Waste		**1**	**1**
Wst 04 Speculative Floor and Ceiling Finishes		n/a	
Wst 05 Adaption to climate change		**1**	**1**
Wst 06 Functional adaptability		**1**	**1**

6.2.8 Land Use and Ecology

Land Use & Ecology	Credits Breakdown	Available Credits	Targeted Credits
LE 01 Site Selection		**2**	**2**
	Previously Occupied Land	1	1
	Contaminated Land	1	1
LE 02 Ecological Value of Site and Protection of Ecological Features		**2**	**2**
	Ecological Value of Site	1	1
	Protection of Ecological Features	1	1
LE 03 Mitigating Ecological Impact		**2**	**2**
LE 04 Enhancing Site Ecology		**2**	**2**
	Ecologist's Report & Recommendations	1	1
	Increase in Ecological Value	1	1
LE 05 Long Term Impact on Biodiversity		**2**	**2**

6.2.9 Pollution

Pollution	Credits Breakdown	Available Credits	Targeted Credits
Pol 01 Impact of Refrigerants		**3**	**3**
	Pre-Requisite: systems with electric compressors		
	Impact of Refrigerants	2	2
	Leak Detection	1	1
Pol 02 NO_x Emissions		**3**	**3**
Pol 03 Surface Water Run off		**5**	**4**
	Flood Resilience	2	2
	Surface Water Run Off	2	2
	Minimising Watercourse Pollution	1	0
Pol 04 Reduction of Night Time Light Pollution		**1**	**1**
Pol 05 Noise Attenuation		**1**	**1**

6.2.10 Innovation

Innovation	Available Credits	Targeted Credits
Man03 Responsible Construction Practices	**1**	**1**

6.3 Credits not targeted but potentially available

The following credits have not currently been targeted, but would also be potential credits to seek if any of the targeted credits become unachievable or are deemed too difficult/costly by the project team or even to improve the rating in order to achieve an 'Outstanding' score:

Potential Credits	Credits Breakdown	Targeted Credits	Potential Credits
Hea 02 - Ventilation	1 credit if air intakes and exhausts are over 10m apart and intakes are over 20m from sources of external pollution; **OR** air intakes and exhausts location is designed in accordance with BS EN 13779:2007 Annex A2	**0**	**1**
Ene 04 - Free Cooling	1 credit if the building uses any of the free cooling strategies below listed below: 1. Night time cooling 2. Ground coupled air cooling 3. Displacement ventilation (not linked to active cooling system) 4. Ground water cooling 5. Surface water cooling 6. Evaporative cooling, direct or indirect 7. Dissecant dehumidification and evaporative cooling using waste heat 8. Absorption cooling, using waste heat 9. No form of active cooling required (i.e. naturally ventilated building)	**0**	**1**
Wat01 - Water Consumption	1 additional credit if more than 50% of potable water consumption is reduced	**3**	**1**
Mat 01 - Life Cycle Impacts	2 additional credits achieved by the use of materials with low environmental impact (Green Guide rating A and/or A+)	**4**	**2**
	Inn: 1 extra credit if four or more building elements achieve at least 2 points in addition to total points under Mat 01 calculation	**Innovation**	**1**

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