# Energy and Sustainability Strategy

22 Ladenham Road, Oxford, Oxfordshire, OX4 6AZ

**PR11065**

**Date:** 12/10/2023

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# Notice



# Document History

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# Contents

# Executive summary

ERS Consultants Ltd has been appointed to prepare an Energy & Sustainability Statement for the site located at 22 Ladenham Road, Oxford, Oxfordshire, OX4 6AZ.

The proposal is for the development of a house. This report will be focusing on implementing careful design and sustainable measures; so that the project creates an attractive new residential unit which will address current housing need within the development area.

Proposed schedules of accommodation are as follows:

**Total Number of Dwellings =** 1 Bungalow

**1 Bungalow**

- Type = 1 x 1 Bedroom property

**Total combined floor area for habitable dwellings: 39.49 m²**

This energy and sustainability strategy outlines the key measures to be incorporated in the design, in regards to sustainability, carbon emissions, renewable energy and environmental impact of the considered development in accordance and with guidance from the following documents and policies:

- Oxford City local plan (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2021

In line with Oxford City Local plan Policy RE1, the development would need to achieve a 40% reduction in regulated $CO_2$ emissions, this development uses an approach to use the carbon factors and figures that have been determined in the latest Part L1 2021 which is a 40% improvement over carbon in comparison to Building Part L 2013.

SAP 10 calculations have been used as this development will effectively be completed on the current Building regulation standards.

This energy & sustainability statement will demonstrate how a selection of sustainable energy efficient measures and low-carbon technologies are used in the reduction of carbon emissions for the development.

A detailed calculation has been undertaken to establish the energy consumption and carbon emissions of the proposed development.

The methodology used to determine the expected operational $CO_2$ emissions for the development is in accordance with the standard three-step Energy Hierarchy and the $CO_2$ savings achieved for each step are outlined below:

## Baseline – (CO2 emissions Part L of the Building Regulation)

Initially in the energy assessment, it must be established that the regulated $CO_2$ emissions of the development comply with Part L SAP10 Standards of the Building Regulations using the approved compliance software for SAP. The baseline regulated CO2 emissions calculated for the site **0.60 Tonnes $CO_2$/Year.**

## Be Lean – Use less energy

The second step addresses, reduction in energy demand, through the adoption of passive and active design measures with emphasis on a fabric first approach.

Emphasis will be put on the buildings fabric performance in order to reduce energy consumption, as less heating and cooling will be lost through the high performance fabric hence reducing the demand. Fabric first measures include levels of insulation beyond Building Regulation 2021 requirements which will help in achieving low air tightness levels.

With the addition of the lean fabric improvements the energy regulated $CO_2$ emissions are shown to reduce by **44.30% (0.33 Tonnes $CO_2$/Year)** for the proposed site.

## Be Clean – Supply energy efficiently

Once demand for energy has been minimised, all planning applications must demonstrate how their energy systems will exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly to reduce CO2 emissions.

When selecting the proposed heating system, it is imperative to consider carbon dioxide emissions, as all combustion processes can emit oxides of Nitrogen (NOx) and, solid or liquid fueled appliances (such as those using biomass or biodiesel) can also emit Particulate Matter. These pollutants contribute to Oxford's poor air quality and can have negative impacts on the health of local residents and occupiers of the development. It is important that these impacts are taken into account in determining the heating strategy of a development.

In this development a highly efficient Air Source Heat Pump have been proposed as the main heating and hot water system, due to the nature of the site.

The space conditioning and hot water system network in this stage of the development will have no changes as there is no need to better the proposed systems applied at the previous development stage of the project.

In this project there will be no direct heating networks or CHP incorporated so therefore, the Be Clean scenario will not further reduce CO2 emissions on site for the proposed development, therefore meaning there are no changes to be implemented to the development.

There is no change from the previous stage and the CO2 emissions remain the same at **44.30% (0.33 Tonnes $CO_2$/Year)** for the proposed site.

## Be Green – Use renewable energy

At this stage of the project, various low-zero carbon options were considered to meet the required reduction. In the end it was decided that all-electric heating systems would be used as stated in the previous step. At this stage, solar PV panels will be installed on the west-facing sloping roof of the property.

By implementing this change, the regulated carbon emissions have been reduced by **58.26% (0.25 Tonnes $CO_2$/Year)** from the baseline.

This concludes this proposed development using the proposed specification in this report completes the **40% Carbon Emissions Reduction** against **future Part L Building Regulations standards by using the Part L 2021 carbon emission factors**.

This development has taken this approach to compliance as the development is to be completed under Part L 2021.

## Energy & carbon demand summary

| Table 1 Energy and Carbon Reductions for Site Wide Reduction | | | | |
|---|---|---|---|---|
| | **Primary energy kWh/year** | **Energy Consumption Savings (%)** | **Total $CO_2$ Emissions (Tonnes $CO_2$/Year)** | **$CO_2$ Emissions Savings (%)** |
| Baseline | 3,182 | | 0.60 | |
| Be Lean | 3,487 | -9.59% | 0.33 | 44.30% |
| Be Clean | 3,487 | 00.00% | 0.33 | 00.00% |
| Be Green | 2,795 | 21.74% | 0.25 | 13.96% |
| **Total Reduction** | | **12.15%** | | **58.26%** |

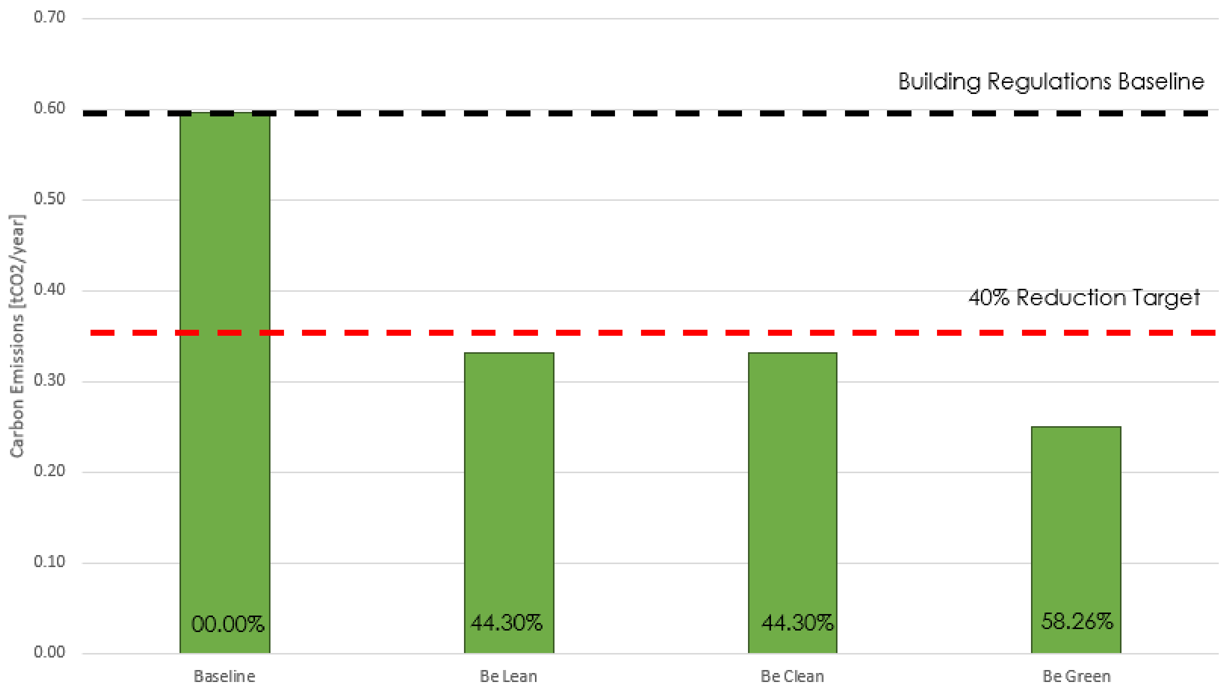



**Fig.1 $CO_2$ Reduction for Site-wide carbon reduction**

SAP calculations always refer to 'regulated' energy loads, which are those addressed by building regulations, 'unregulated' loads, for example is energy used by white goods and cooking.

As shown in Table 1, the provisional baseline annual carbon dioxide emissions of the proposed development have been calculated to achieve **0.60 Tonnes $CO_2$/Year** for the site and through the design development this has been reduced to **58.26% (0.25 Tonnes $CO_2$/Year).**

| Table 2: Proposed Fabric Specifications | | | |
|---|---|---|---|
| Fabric Construction and Insulation | | | |
| **Element** | **Type** | **U-Value** | |
| **Heat Loss Floor** | Ground Floor - Solid | 0.12 | |
| **External Walls** | Cavity Wall | 0.18 | |
| **Roof** | Pitched – insulated at rafters | 0.15 | |
| **Windows** | Window | Double glazed, argon filled, 16mm unit with low-e coat and thermally broken lintel, IG or similar; G-Value of 63%; Frame Factor of 70%; | 1.30 |
| **Rooflights** | Roof Window | Double glazed, argon filled, 16mm unit with low-e coat and thermally broken lintel, IG or similar; G-Value of 63%; Frame Factor of 70%; | 1.30 |
| **Solid Door** | Solid Door | Solid or minimally glazed (<30%) insulated unit with thermally broken lintel; | 1.30 |

<table>
<tr><th colspan="6">Table 3: Proposed System Specifications</th></tr>
<tr><th colspan="6">Space Heating</th></tr>
<tr><td>Main Heating System</td><td colspan="5">SAP default Air Source Heat Pump used for Energy Statement calculations; Radiators;</td></tr>
<tr><td>Heating Controls</td><td colspan="5">Time and temperature zone control;</td></tr>
<tr><td>Secondary Heating</td><td colspan="5">N/A;</td></tr>
<tr><th colspan="6">Water Heating</th></tr>
<tr><td>Heat source</td><td>From Main Heating</td><td>Cylinder Size</td><td>170 litres</td><td>Heat Loss</td><td>1.63 kWh/Day</td></tr>
<tr><td>WWHRS Instantaneous System 1</td><td>N/A</td><td>WWHRS Instantaneous System 2</td><td colspan="3">N/A</td></tr>
<tr><td>Water Use <=125 l/p/d</td><td>Yes</td><td>Cold Water Source</td><td colspan="3">From Mains</td></tr>
<tr><td>Shower(s)</td><td>Combination boiler or unvented hot water system</td><td>Flow Rate [l/min]</td><td>9 l/min</td><td colspan="2">Connected to the Hot Water Cylinder</td></tr>
<tr><td>Bath Count</td><td>1</td><td colspan="4">Cylinder Pipework is fully insulated where possible; Full cylinder heating controls installed;</td></tr>
<tr><td>Solar Thermal</td><td colspan="5">Not Installed;</td></tr>
<tr><th colspan="6">Ventilation</th></tr>
<tr><td>Mechanical Ventilation System</td><td>Intermittent Extract;</td><td colspan="2">Number of Wetrooms, excluding kitchen</td><td colspan="2">1</td></tr>
<tr><td>Cooling system</td><td colspan="5">Not installed;</td></tr>
<tr><td>Pressure Test Blower Door</td><td colspan="5">5.00m³/hm² @ 50 Pa Please note ERS can provide Air Leakage Testing</td></tr>
<tr><th colspan="6">Other</th></tr>
<tr><td>Detailing (linear thermal bridging junctions – formerly ACDs)</td><td colspan="5">Enhanced construction details from the insulation manufacturer have been used where available. The dwelling must be constructed to this standard, and the relevant forms must be completed as building work progresses. Any deviation from this will require an update to the SAP calculations as the psi-values will change; Building Alliance Recognised Constructions Details; Masonry Cavity Wall Full Fill; 150mm/0.32W/mK/0.28W/mK; Unilin details used for R1/R2/R3;</td></tr>
<tr><td>Lighting</td><td colspan="5">No. Fittings: 12; Power [W]: 2; Efficacy [lm/W]: 75; Capacity [lm]: 150</td></tr>
<tr><td>Tariff and Meters</td><td colspan="5">Standard; Smart Electricity Meter: Yes; Smart Gas Meter: No</td></tr>
<tr><td>PV/Renewables</td><td colspan="5">0.9kWp PV west-facing to angle of roof;<br>Export Capable Meter;</td></tr>
<tr><td colspan="6">Please note: There may be upgrades compared to your original specification to achieve building regulation approval under the relevant Approved Document Part L. Failure to implement these upgrades may result in a Building Regulation Failure at final stage. Please ensure any changes to the specification are made through this office to ensure ongoing compliance.</td></tr>
</table>

# Introduction

## Site & proposal

The site is located at **22 Ladenham, Oxford, Oxfordshire, OX4 6AZ**

**Gross Internal Area for the dwelling: 39.49m²**

The approximate site location of the proposed development is shown in the site plan Fig.2.

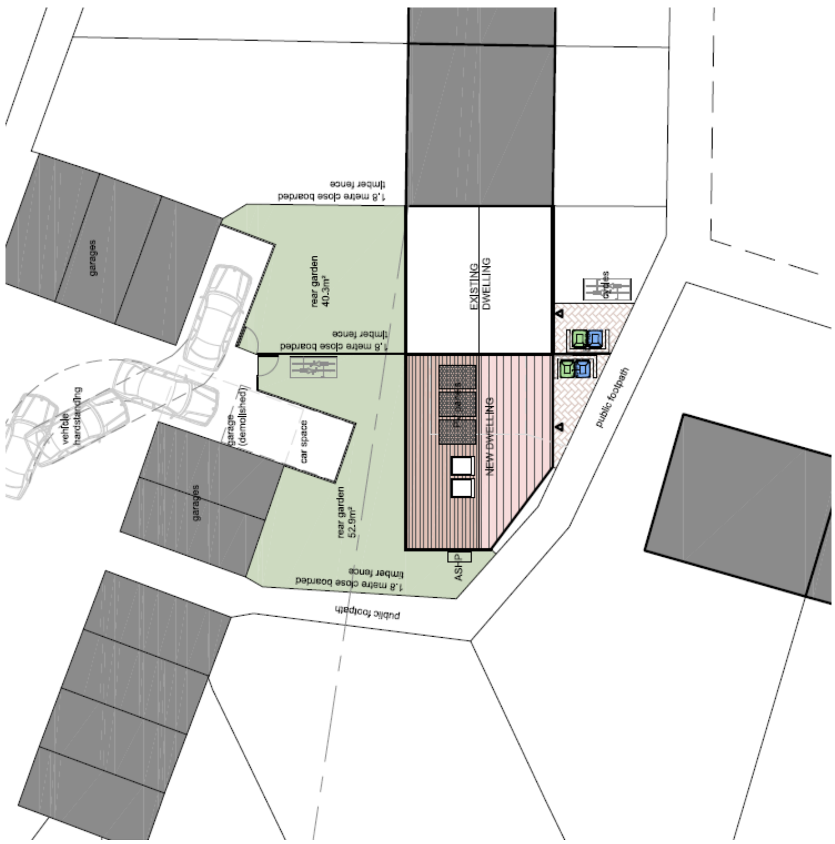



**Fig.2 Site Plan**

## Policy context

This energy and sustainability statement will seek to respond to the energy policies that apply to this development. The most relevant applicable energy policies in the context of the proposed development are presented below.

- Oxford City local plan (Policy RE1)
- The National Planning Policy Framework (NPPF) July 2021

All the aforementioned policies focus on zero carbon targets for residential developments with a minimum **40%** on site reduction beyond Part L 2021.

## Calculation methodology

The sections below present the methodology followed in determining carbon emissions reduction savings for the proposed scheme.

The methodology employed by the energy and sustainability statement is in line with the GLA's Guidance on preparing energy assessments.

The baseline $CO_2$ emissions are first established, i.e., the emissions of a scheme that is compliant with Part L 2021 of the Building Regulations.

The approved software used to model and calculates the energy performance and carbon emissions are SAP 10 Online version by Elmhurst Energy Systems Ltd.

To calculate our results for the site-wide development a suitable sample number of units is selected and the results are scaled up as per the proposed development Gross Internal Area.

The TER which is used as the baseline figure for the carbon reductions for each domestic element is multiplied by its floor area to establish the total baseline emissions.

*Baseline:*

The property baseline uses the same heating system as per the designed counterpart; therefore, in this exercise the baseline models also use Mains Gas as the main source of heating on the calculations. The full specification of the baseline can be found in Table 1.1 of the Approved Document L Volume, 2021 Edition.

*Be Lean: use less energy*

The demand for energy is reduced through a range of passive and active energy efficiency measures; as part of this step the dwelling fabric u-values and glazing have been improved to a high standard, in addition to this suitable heating systems are utilised as per the specifications in Table 2 and 3.

*Be Clean: supply energy efficiently*

As much of the remaining energy demand is supplied as efficiently as possible in the previous stage, we consider the option of communal and network-based heating strategies, but due to high costs and the scale of the development this is not a viable option.

*Be Green: use renewable energy*

Renewable and low-zero carbon technologies are incorporated to offset part of the carbon emissions of the development. The uptake of renewable technologies is based on feasibility and viability considerations, including their compatibility with the energy system determined in the previous step.

The implementation of the Energy Hierarchy determines the total regulated carbon savings that can be feasibly and viably achieved on site.

The 40% improvement for the development against the baseline emissions is compared to the relevant targets for each element and in case of a shortfall; savings through off-site measures should be achieved.

The Conclusions section summarizes the energy strategy and associated carbon savings for the proposed development.

The carbon emissions factors used in all calculations in this document are those used for Part L of the Building Regulations. The relevant factors are reproduced in Table 4 below.

| **Table 4 Carbon Emission Factors for selected fuel type** | | |
|---|---|---|
| **Fuel** | **Emissions kg CO2e per kWh** | **Primary energy factor** |
| **Mains Gas** | 0.210 | 1.130 |
| **Bulk/Bottled LPG** | 0.241 | 1.141 |
| **Liquid Fuels** | 0.024 | 1.286 |
| **Heating Oil** | 0.298 | 1.180 |
| **Wood Pellets** | 0.053 | 1.325 |
| **Grid Electricity** | 0.136 | 1.501 |

* Table extracted from the document SAP Version 10.2 (21-04-2022). Table 12: Fuel prices, emission factors and primary energy factors, Page 189. this can be found in the appendix of the report.

# Be Lean – Use less energy

The proposals incorporate a range of passive and active design measures that will reduce the energy demand for space conditioning, hot water, and lighting.

Measures will also be put in place to reduce the risk of overheating, the regulated carbon saving achieved in this step of the Energy Hierarchy is **44.30%** when compared against the baseline level for the development.

## Passive design measures

### Materials and Waste

A site waste management plan that provides details of waste minimisation, sorting, reuse and recycling procedures is required for all levels in the planning guidance. Sustainable waste management should follow the hierarchy described in *BS 5906: Waste management in buildings. Code of practice*. This outlines the following principles in decreasing order of desirability:

- Reuse land and buildings wherever feasible and consistent with maintaining and enhancing local character and distinctiveness.
- Reuse and recycle materials that arise through demolition and refurbishment, including the reuse of excavated soil and hardcore within the site.
- Prioritise the use of materials and construction techniques that have smaller ecological and carbon footprints, help to sustain or create good air quality, and improve resilience to a changing climate where appropriate.
- Incorporate green roofs and/or walls into the structure of buildings where technically feasible to improve water management in the built environment, provide space for biodiversity and aid resilience and adaptation to climate change.
- Consider the lifecycle of the building and public spaces, including how they can be easily adapted and modified to meet changing social and economic needs and how materials can be recycled at the end of their lifetime.

Space is provided and appropriately designed to foster greater levels of recycling of domestic waste.

## Using Recycled/Recyclable Materials and Sourcing them Responsibly

**The following measures will be put in place to minimise environmental impact**

Regard for reuse & efficient use of materials: Material efficiency will be a priority for the design team and will be one of the key considerations during detailed design. Potential measures for reducing the material demand and for designing out waste will be explored by all key design team disciplines at each design stage, according to the first stages of the Waste Hierarchy.

Regard will be given to reducing the use of virgin materials, such as ensuring a recycled aggregate of content 10-15% in concrete, for example.

Specifically, the following notes have been made on the durability and recycling potential of project materials:

- Brick in the wall finishes has a long usable life and can be reclaimed / re-used in the future. It can also be recycled although it is a more a down-cycle into rubble material for aggregates.
- Window glass, carpeting, and concrete can also be down-cycled.
- The hard landscaping has many timber elements (seats, benches, fences, the acoustic fence) which is a renewable material and is likely to be FSC certified. It can also be recycled or down-cycled into chipboard / crushed timber.
- Off-site construction and Prefabrication; An effective way of managing materials efficiency is through off-site construction or 'Prefabrication', meaning that major components of buildings are manufactured off-site and assembled on-site. This has many benefits, as factory environments help to ensure quality of construction, reduce waste because of spoilage on site (e.g., due to poor storage practices or inclement weather) and encouraging the re-use of materials that otherwise may be wasted. This will be actively explored particularly in relation to the houses.
- Similarly, the use of pre-made sections, such as pre-cast floor slabs in the flatted element will reduce waste and maximise material efficiency. A study by the HSE concluded that waste reductions approaching 70% were possible when compared with traditional techniques.
- The design seeks to use prefabrication for some internal spaces and will be used, subject to the availability of skilled labour and resources within a reasonable distance of the site.

- The design utilises stacking, repeating floor plans where possible within the site constraints, making the use of modular construction possible. If this is a viable option it would reduce transport journeys, reduce site congestion and increase safety.

**Environmentally conscious materials**

- Materials with the lowest environmental impact tend to have only minimal processing requirements and contain as many naturally occurring constituents as possible. The design team will ensure that 'good practice' is implemented in the specification of materials, making conscious decisions to specify more natural products and wider environmental impact of the materials will be considered when choosing between different options. This could include reviewing Environmental Product Declarations.

- Furthermore, efforts will be made to use materials with low/zero Global Warming Potential (GWP), low Ozone Depletion Potential (ODP) and low embodied energy.

- Local and responsible sourcing Transport associated with extracting, processing and delivering materials can contribute significantly to their carbon and environmental footprint. A robust system of responsible materials sourcing will ensure that native materials will be used as a matter of preference, before any are sourced internationally. It is reasonable to expect as well that deliveries will be made using fuel efficient vehicles.

- The responsible sourcing of materials will be a key consideration in the selection of suppliers, and a sustainable procurement strategy will be produced for the development prior to construction.

- Materials from suppliers who participate in responsible sourcing schemes such as the BRE BES 6001:2008 Responsible Sourcing Standard will be prioritised where economically possible.

Where there are suitable opportunities to recycle a proportion of the material recovered from the existing site it should always be done.

## Enhanced U-values

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

The proposed development will incorporate high levels of insulation and high-performance glazing beyond Part L 2021 targets and notional building specifications, to reduce the demand for space conditioning (heating and/or cooling).

Table 5 demonstrates the improved performance of the proposed building fabric beyond the Building Regulations requirements.

| **Table 5 Proposed fabric U-Values** | | |
|---|---|---|
| **Domestic (U-Values in W/m²k)** | | |
| **Element** | **Part L 2021 Building Regulation** | **Proposed** |
| Wall | 0.26 | 0.18 (External Wall) |
| Floor | 0.18 | 0.12 (Ground floor) |
| Roof | 0.16 | 0.15 (Sloped Roof) |
| Windows/ Glazed Doors | 1.60 | 1.30 |
| Rooflights | 2.20 | 1.30 |
| **These u-values are recommended but may change during the construction stage, to meet site constraints, any worsening of the u-values must ensure the required 40% reduction in Carbon is met before completion;** | | |

## Air tightness improvement

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

The proposed development will aim to improve upon the Part L 2021 minimum standards for air tightness by targeting air permeability rates of **5.00m³/m².h at 50Pa for the unit**, should the air test be below 3.00m³/m².h at 50Pa Mechanical ventilation will be required.

*Reducing the need for artificial lighting*

The development has been designed to maximize daylight in all habitable spaces as a way of improving the health and wellbeing of its occupants.

Natural light Natural lighting reduces the energy used for artificial lighting and creates a healthier internal environment. Issues to consider include how much of the sky is visible through a window (the more, the better), the dimensions of the interior living/working space and distance from the window, and the proportion of glazed surfaces. The depth of the room is an important factor in determining the amount of natural light received. Naturally dark rooms may be lit naturally through measures such as sun tubes which 'pipe' sunlight from sunny areas to internal areas.

Glare created by natural or artificial light can be uncomfortable for people both inside and outside a building. This can be minimised if considered early in the design process through building layout (e.g., low eaves height) or building design (e.g. blinds, brise soleil screening). If considered together with a lighting strategy this can reduce energy consumption.

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

## Active design measures

### *High efficacy & low energy lighting*

Where artificial lighting will be needed it will low energy lighting without compensating for luminance, and will accommodate LED.

### Water

Policy RE1 requires water efficiency in new development to meet the highest national standard. For residential development, this is defined in the supporting text as the 'optional Building Regulation' for water efficiency in new dwellings, which is 110 litres per day per person, or a tighter standard if one becomes available nationally. If a new, tighter national standard is introduced, this will be adopted automatically by virtue of Policy RE1.

There are presently no other national standards for non-residential developments than those in the Building Regulations. However, the principle of water efficiency in line with the waste hierarchy applies to all developments. As a result, all developments should seek to reduce demand through efficiency measures, and then meet remaining demand from sustainable sources wherever possible.

For all developments, the submitted information should set out an approach to water management that reduces water usage and waste and priorities demand reduction measures over supply measures.

### Reducing water use

Development, whether new construction or change of use and refurbishment, can save water by including measures such as:

- systems for greywater reuse
- aerated washbasin/kitchen taps and shower heads,
- tapered and low-capacity baths,
- sensor and low flush toilets, shower timers, and,
- water efficient white goods and appliances such as washing machines and dishwashers.

**Water use during construction can be reduced through measures including:**

- closed loop wheel washers,
- waterless wheel washing using angled steel grids to remove debris,
- high pressure low volume power hoses, recirculating water where possible,
- limiting the water used for flushing building services by stopping it as soon as the flush water turns clear, and
- employing a regime for monitoring water use and water waste.

Choosing the best location for a boiler can reduce water consumption and heat loss. By minimising the length of hot water pipes the volume of water that must be drawn off each time a tap or shower is used can be reduced. Positioning hot water pipes above pipes carrying cold water will reduce heat transfer. Further heat loss can be reduced by insulating the piping.

For all new dwellings, a completed “water efficiency calculator for new dwellings” worksheet that accords with Part G of the building regulations’ Approved Documents should be provided prior to occupation. The calculation must demonstrate that the new dwellings will achieve a maximum water usage of 110 litres per person per day.

### Rainwater harvesting

Rainwater harvesting is the collection of rainwater directly from a surface it falls on (e.g., a roof). Once collected and stored it can be used for non-potable purposes such as watering gardens, supplying washing machines and flushing toilets, thereby reducing consumption of potable water. Potable water is produced through a purification process and is pumped over large distances, both of which require energy and result in embodied carbon that is not present in water harvested locally. In a residential development, rainwater can be captured for domestic use using water butts connected to a down pipe. Larger systems can use water stored in underground water tanks.

Schemes should be designed to include space for water storage. In residential developments, down pipes should be carefully placed so that water collection and use is convenient for residents.

### Greywater re-use

Water that is recycled from bathrooms and kitchens for non-potable uses is known as greywater. Greywater systems must ensure treatment on a regular basis to prevent a build-up of bacteria, and some systems are powered, which entails an energy cost. As a result, greywater reuse is generally less preferable than water use minimisation measures.

Water recycling systems are better suited to new developments rather than retrofitting in existing buildings because of the excavation required for storage tanks and changes needed to the plumbing system, and they are generally more cost effective for new developments and developments of a larger scale.

Recycling systems should be backed up by a mains supply or a sufficiently large reserve storage system to meet higher demands during dry spells. Storage tanks will need an overflow to allow excess water to be released which should be able to flow into a soakaway.

### *Controls and Monitoring*

Advanced lighting and space conditioning controls will be incorporated, specifically:

- For areas of infrequent use, occupant sensors will be fitted for lighting, whereas day lit areas will incorporate daylight sensors where appropriate;
- Heating and cooling systems controls will comprise time and temperature controls, both centrally for the whole building, and locally for each space;
- Smart metering to be installed on all new dwellings for adequate monitoring;

## Overheating Risk analysis

Passive solar gain refers to the process whereby a building is heated by the sun, either directly from sunlight passing through a window and heating the inside of the building, or indirectly as sunlight warms the external fabric of the building and the heat travels to the interior. The level of passive solar gain can significantly impact upon the quality of a building, how it is used and the energy needed for it to be inhabited comfortably. Passive solar gain can reduce the need for mechanical heating, which in turn reduces energy use and carbon emissions.

Key factors that influence passive solar gain include the physical characteristics of the site, immediate surroundings, orientation of buildings, external design, internal layout and the construction materials used.

Whilst passive solar gain can reduce the carbon emissions associated with heating, if used incorrectly it can lead to overheating, which in turn can lead to the installation of mechanical cooling equipment (e.g., air conditioning). Mechanical cooling increases energy consumption and requires maintenance, resulting in costs and carbon emissions. Mechanical cooling units also produce heat that requires dissipation. The need for mechanical cooling can be avoided or lessened by designing-in passive ventilation and passive cooling measures. Developments should not incorporate mechanical cooling unless passive measures have been fully explored and appraised and proposals that include mechanical cooling should clearly demonstrate that passive measures would not be adequate.

The potential overheating for the development is to be assessed in accordance to Part O of the Building Regulation. Utilising the simplified approach is the first protocol to ensure the scheme does not over heat, where the simplified approach fails to meet the required reduction, a dynamic simulation will need to be undertaken. This assessment will be taken post planning approval.

**The following list includes some of the key considerations in the design of new schemes:**

- Rooms that are most frequently occupied should benefit from a southerly aspect, but with appropriate measures to avoid overheating.

- Orientation and layout of habitable rooms, and window size and orientation, should be carefully considered in relation to the path of the sun.

- Rooms that include a concentration of heat generating appliances (e.g., kitchens) or are less frequently occupied (e.g. bathrooms) should be located in the cooler part of the building, generally the northern side.

- Conservatories and atria can be used to assist natural ventilation in the summer by drawing warm air upward to roof vents, and to collect heat during the spring and autumn.

- Deep projections that overshadow windows should be avoided, particularly on south facing elevations. Projections should be sized appropriately so that they provide shading from the sun during the hottest part of the year but allow solar gain in the colder months.

- Where there is a chance that overheating can occur (e.g., due to large expanses of glazing on roofs and south facing elevations), design measures such as roof overhangs, brise soleil, external shuttering, photochromatic and thermochromic glass and a lighter colour palette can help.

- Zonal heating and ventilation systems and controls can be used allowing areas subject to high solar gain to occupy their own temperature control zone. Dynamic controls reduce energy waste.

- Use of materials to build in thermal mass to absorb excess heat during warmer periods and release it slowly during cooler periods (e.g., day/night, summer/winter).

- Buildings should be designed for passive ventilation:
    - cross ventilation with windows located on opposite walls and/or roof mounted turbines or wind cowls that assist with circulation of air by drawing air through windows or top floor openings and
    - passive stack ventilation (PSV) that uses pressure differences to draw in fresh air from outside to replace rising warm air which is released from the top of the building. A heat exchanger can be placed where the air escapes the building to reduce heat loss.

### Be Lean $CO_2$ emissions & savings

By means of energy efficiency measures and suitable heating systems, regulated $CO_2$ emissions for the property are shown to reduce by **44.30%** compared to the baseline.

## Be Clean – Supply energy efficiently

There are no changes from the previous stage, however research into low carbon energy sources is still completed as a due diligence for the alternative solutions. Carbon Emissions Reduction is shown to remain at **44.30%** compared to the baseline.

### Low Carbon Energy Sources

#### Combined Heat and Power (CHP)

The presence of a year-round base hot water generation heat load in residential units is favourable to CHP. To date, there are readily available micro gas fired CHP units (such as EC power) on the market. At this stage gas fired CHP will be provisionally incorporated into the development's LZC strategy, however, the carbon reductions due to CHP are extremely sensitive to the system design, unit selection and running time.

CHP (Combined Heat & Power) is a great technology to use, however the system itself needs to run on a 24-hour basis. The heat generated would be exceeding the demand and needs for this site, and would require to have an outlet area which can profit from this excess; however, this development does not have a space that benefit from this; therefore, this option has considered not feasible for this development.

#### Heat Networks

All new developments should look connect, or be connection ready, where a heat distribution network already exists. The investigation of opportunities should cover all scales and should not be limited to district heating systems.

Where such networks exist and developments should propose to connect to them, the energy statement should set out details showing how connection will occur (a connection strategy). Where such networks exist, and developments do not propose to connect to them, the energy statement must set out clear reasons as to why the connection is not feasible, or why an alternative source of energy would be more sustainable.

The development is currently located in a site where local heat networks are present, so therefore it is concluded that connection into a heat network is not feasible.

# Be Green – Use renewable energy

## Renewable technologies feasibility study

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

This section provides an overview of the technologies considered, a brief assessment of their feasibility, a proposed mixture of suitable technologies.

The proposed development will benefit from an energy efficient building fabric which will reduce the energy consumption of the proposed development in the first instance.

A range of renewable technologies were subsequently considered including:

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

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

- $CO_2$ savings achieved;
- Site constraints;
- Financial benefit
- Any potential visual impacts

*Demand profiles*

The balance of technologies chosen will depend on the development's energy demand patterns.

Keeping in mind that the space heating energy demand changes according to the season. While hot water energy demand will provide a significant base load throughout the year.

Electrical demand is likely to be moderate throughout the year. Lighting loads will be highest during the evening but will continue at reduced levels throughout the night and during the day.

### *Feasibility*

At this early stage in the design, it is possible only to outline the likely feasibility of specific technologies. Further descriptions of the LZC technologies below are included in Appendix A.

| Table 6. Renewable and Low Zero Carbon Technologies | | | | | | |
|---|---|---|---|---|---|---|
| **Renewable Technology** | Comments | Lifetime (Years) | Maintenance | External Impact | Site Feasibility | Adopted for Site |
| **BIOMASS**  | Burning of wood pellets releases high NOx emissions and there are limitations for their storage and delivery within an urban location. | 20 | High | High | 1 | ☐ |
| **PV**  | PV panels would generate significant carbon savings, whilst having minimal impact on the appearance of the building and no adverse impact on the amenity of neighbouring buildings. | 25 | Low | Med | 9 | ▣ |
| **Solar Thermal**  | Solar thermal array mounted on the roof may contribute to carbon reductions, but will reduce the amount of available roof space where Photo voltaics are proposed | 25 | Low | Med | 7 | ☐ |
| **Air/Ground Source Heat Pump**  | Ground loops requires space, additional time at the beginning of the construction process and very high capital costs, however in terms of the air source heat pump solution is a viable and cost-effective solution to meet the required carbon reductions. | 20 | Med | Low | 9 | ▣ |
| **Wind**  | Due to insufficient open area for installation of a stand-alone wind turbine and planning issues this option has not considered in this development. | 25 | Med | High | 0 | ☐ |

## Detailed assessment of Photovoltaic Panels

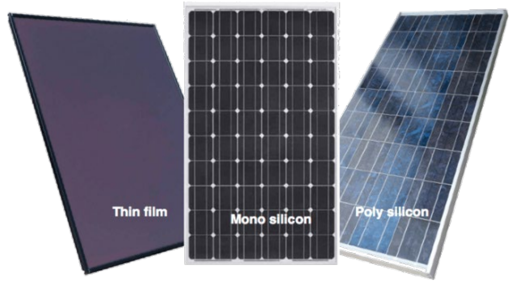



**Fig 3. Photovoltaic Panels**

Four types of solar cells are available on the market at present and these are mono-crystalline, polycrystalline, thin film and hybrid panels as seen in Figure 3. Although mono-crystalline and hybrid cells are the most expensive, they are also the most efficient with an efficiency rate of 12-20%. Poly-crystalline cells are cheaper but they are less efficient (9-15%). Thin film cells are only 5-8% efficient but can be produced as thin and flexible sheets.

Air Source Heat Pumps is considered as a highly efficient low zero carbon technology solution to meet the required carbon reductions for the houses.

Photovoltaic Panel is considered a suitable technology as the development provides an extent of roof space for the installation of PV panels. In addition to this the PV arrays are relatively easy to install when compared to other renewable systems and provide a significant amount of $CO_2$ savings.

The PV shall comprise **0.90kWp** of sloped roof mounted arrays on the dwelling; Table 7 summarizes the technical data for the proposed PV array. In total, the PV installation would produce a further regulated $CO_2$ savings of **13.96%** for the **development**.

| Table 7. Proposed PV Specifications | |
|---|---|
| **Photovoltaic Panels** | |
| Module Efficiency | 15% |
| Panel Orientation | West facing |
| Tilt | To angle of roof |
| Power to be installed | 0.90kWp |
| Energy Generation | 691.79kWh/yr |
| **$CO_2$ savings** | **83.15 kg$CO_2$/yr** |

## Be Green $CO_2$ emissions & savings

The incorporation of renewable technologies will further reduce $CO_2$ emissions of the Site by a further **58.26%** compared to the baseline.

*Sustainable Urban Drainage Systems (SuDS)*

SuDS offer multiple benefits – they can help to manage flood risk, improve water quality, provide opportunities for water efficiency, enhance landscape and visual quality, provide amenity value and offer opportunities for biodiversity. The design of SuDS should explore fully the potential to deliver these benefits.

SuDS limit the volume and rate of surface water entering the public sewer system. They therefore have the potential to play an important role in helping to ensure the sewerage network has the capacity to cater for population growth and is resilient to the effects of climate change.

# Flood zone risk assessment for planning

The Environment Agency has developed a flood risk map for planning to identify the relative risk of flooding for proposed development planning locations. Flood zones assume that no defences are present and so where these do exist, they are only indicative of the potential for flooding.

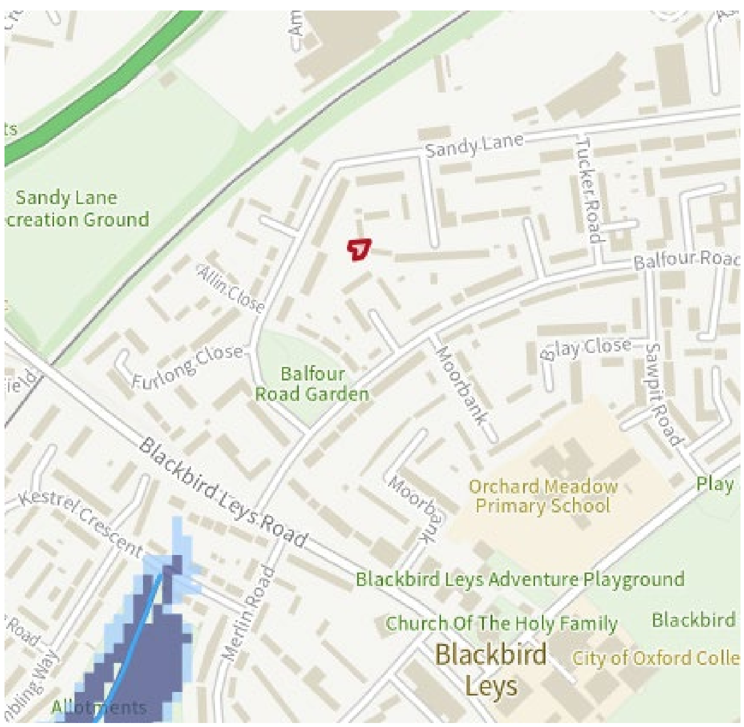



**Fig 4. Environment Agency Flood Zone Interactive Map**

The whole of the development lies within flood zone 1 of the Environment Agency's flood risk map as seen in fig. 4. Land located within flood zone 1 is at low risk of flooding having an associated annual probability of flooding of less than 1 in 1000 (0.1%).

## Study approach

In accordance with Planning Practice Guidance for Flood Risk document, land within flood zone 1 is suitable for all uses. Assessment of this site has been based upon the Environment Agency's flood interactive map, the topographical site survey and the architect's proposed development layout.

## Flood vulnerability

Based on the Environment Agencies flood map, the development site is located within Flood Zone 1 and in accordance with Planning Practice Guidance for Flood Risk neither a sequential or exception test is required.

## Conclusion

Following the implementation of the three-step Energy Hierarchy, the regulated $CO_2$ savings for the site are calculated at **58.26%**, against Part L 2021 SAP 10 performance standards. The baseline annual energy consumption of the site on this development have been calculated to be **0.60 Tonnes $CO_2$/Year** of CO2 emissions. By incorporating on-site renewable/ LZC technologies the total CO2 emissions will be reduced to **0.25 Tonnes $CO_2$/Year**.

Overall, the proposed development has been designed to meet energy policies set out by the proposed development local and national planning requirements, which demonstrates the client and the design team's commitment to enhancing sustainability of the scheme.

The new development will be designed with a high level of insulation and low air permeability to reduce heat loss as much as is practically possible, also the use of low energy lighting and A – Rated White goods are essential for the reduction of energy consumption.

The control strategy throughout the proposed site must be carefully designed to ensure the most economical operation of all equipment.

To achieve the required reduction of carbon emissions, several options were considered, however the best option in regards to site location and the development size, was the installation of an Air Source Heat Pump and solar PV units on the sloped roof. Different possible renewable energy options have been identified; bearing in mind that selection is a complex process which requires a more detailed estimation of energy demand patterns; therefore, further analysis will be undertaken as the design progresses.

The proposed development site is not in a close proximity of an existing heat network making this an unviable solution to improve the heating system in the dwelling at time of this application.

The dwelling is to have suitable meter/smart meter management installed on every household, so that the homeowner can benefit from accurate savings to allow for suitable management of energy usage.

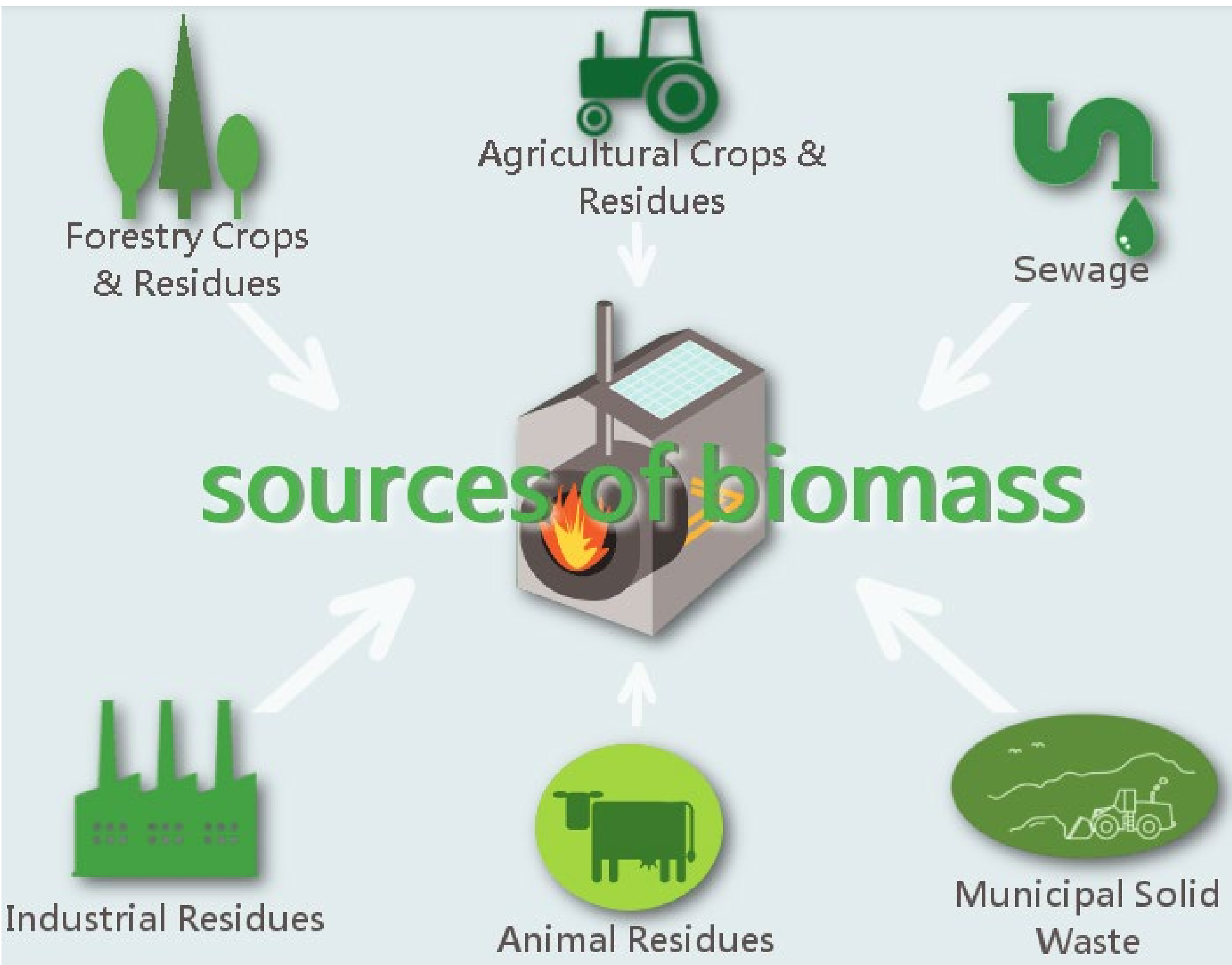
Post construction the dwelling is to have suitable testing to be provided to ensure the dwellings satisfy the requirements of this document and building regulation standards at the time of completion. This report is to be provided along with as As-Built SAP worksheets, EPC and Air testing, for all conditioned spaces in the development.

# Appendix A - Low or Zero Carbon Energy Sources

## Biomass As a fuel

Biomass is a renewable energy source, generated from burning wood, plants and other organic matter, such as manure or household waste. It releases CO2 when burned, but considerably less than fossil fuels. We consider biomass a renewable energy source, if the plants or other organic materials being burned are replaced.

Biomass is known for its versatility, given it can be used to generate heat, electricity, be used in combined heat and power units and be used as liquid fuel. In domestic settings, it tends to be found in the form of wood-fueled heating systems.



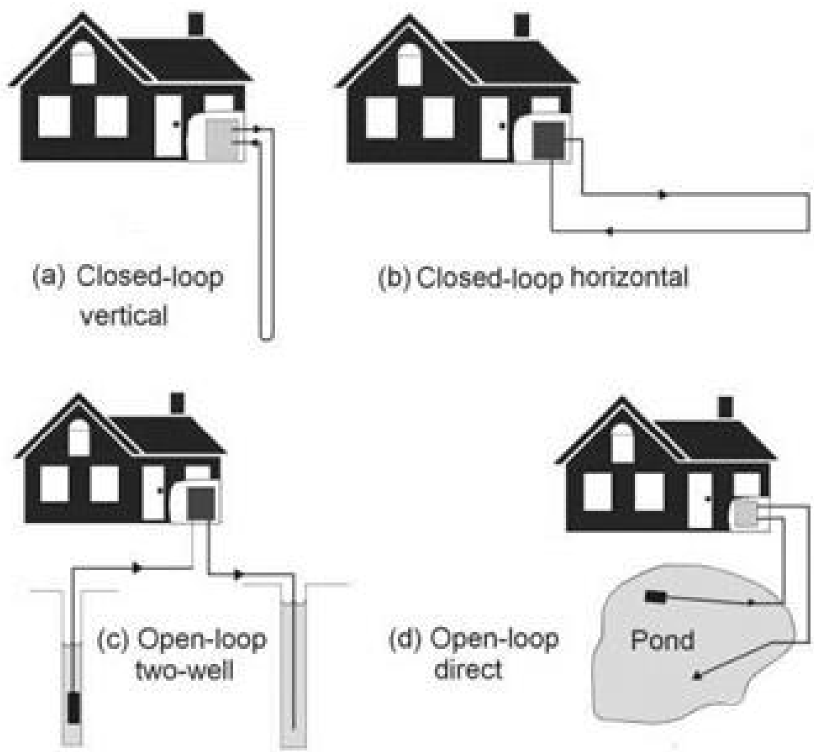

## Geothermal Energy:

Geothermal energy technologies use the heat energy stored in ground; either for direct-use applications: such as using the grounds' heat to defrost a driveway or the indirect use with additional equipment such as a geothermal heat pump. Most commercial installations couple a heat pump with the ground to upgrade the low-grade heat from the ground or ground water to a higher-grade heat, where it can be used for heating purposes.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used:

## Ground source earth coupling options

The right choice of appropriate heat exchanger depends on several factors such as: size of space heating/hot water system, available site area for the heat exchangers, and local ground conditions. Due to the specialist nature of this technology, we recommend that a specialist is employed to size the heat exchangers based on a desk-top study of the site's geological conditions – this normally being required in advance of any other contractor appointment.




## Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop.

Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

## Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

## Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Ground source heat exchange options in summary:

### Vertical loop system - closed boreholes

- moderate heat capacity
- relatively low installation cost

### Vertical open system - open boreholes

- high heat capacity
- high running energy
- high installation cost

### Horizontal loop system – straight pipes

- low capacity,
- high installation cost
- extensive ground excavation work

### Horizontal coiled loop system – 'slinky' pipes

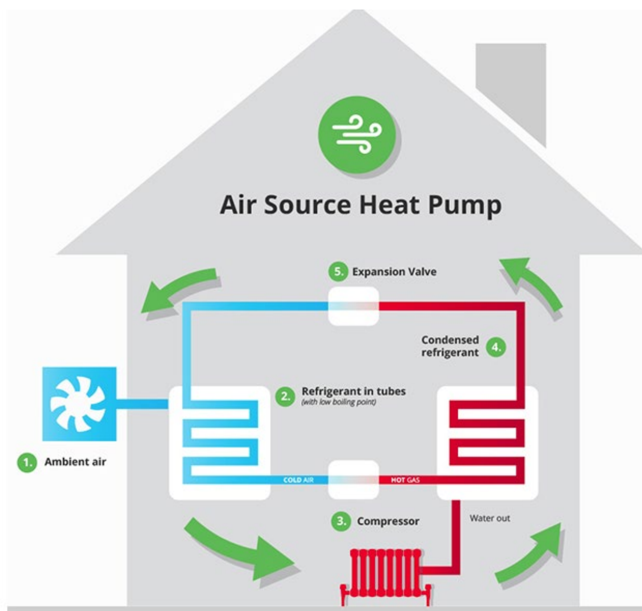
- good capacity
- low installation cost
- extensive ground excavation work

## Air Source Heat Pumps

Heat pumps are basically refrigeration units which work in reverse – instead of cooling being produced and heat rejected, the unit produces heat and rejects cooling. Conventional heat pumps use air as the medium to reject this 'coolth' to atmosphere. Ground source units use the ground as a means of improving the unit efficiency because the ground is a constant 11-13 °C at depths of 50m down – this suits the heat pump much better during the coldest weather than the extremes of air temperature. Reversible heat pumps can also be used for cooling, however this is not being considered further for this project.

A heat pump consumes electrical power to drive the compressor and other ancillary elements. The ratio between total energy input and heat energy output of the heat pump is a measure of its efficiency – usually referred to as 'Coefficient of Performance' - COP. A ground source heat pump has a higher COP than an air cooled heat pump – this additional energy effectively being the grounds' natural contribution to the system.

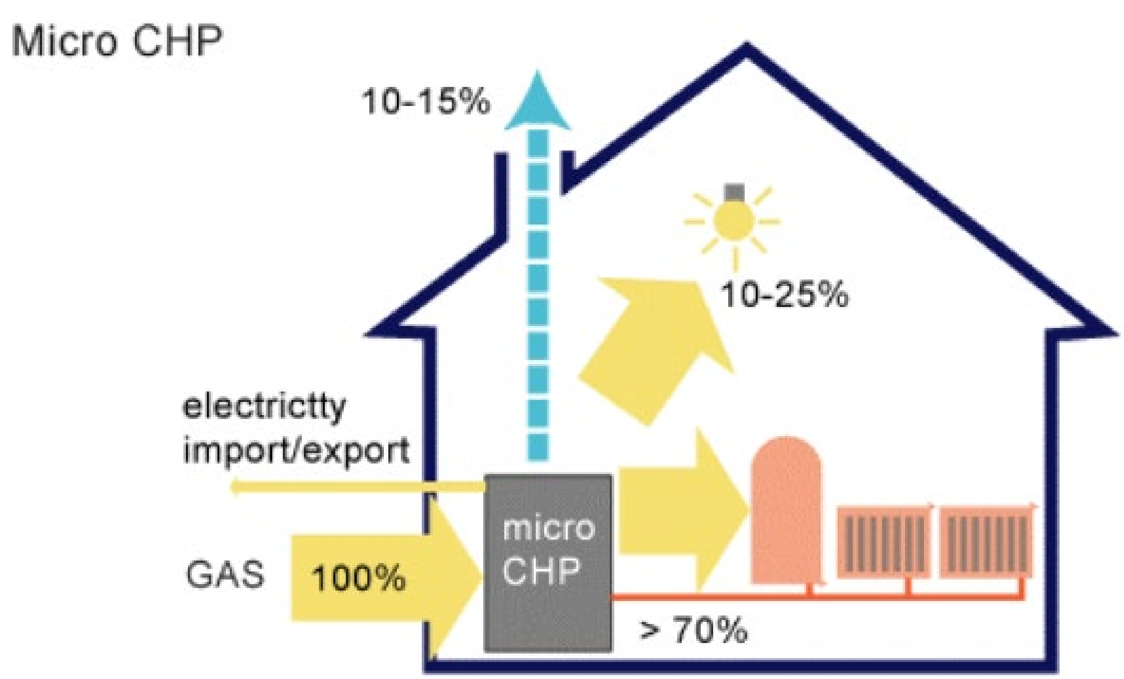
The heat produced by a heat pump is usually used to either provide space heating say to underfloor heating or radiators or the heat is used to generate domestic hot water via a storage vessel.



## CHP

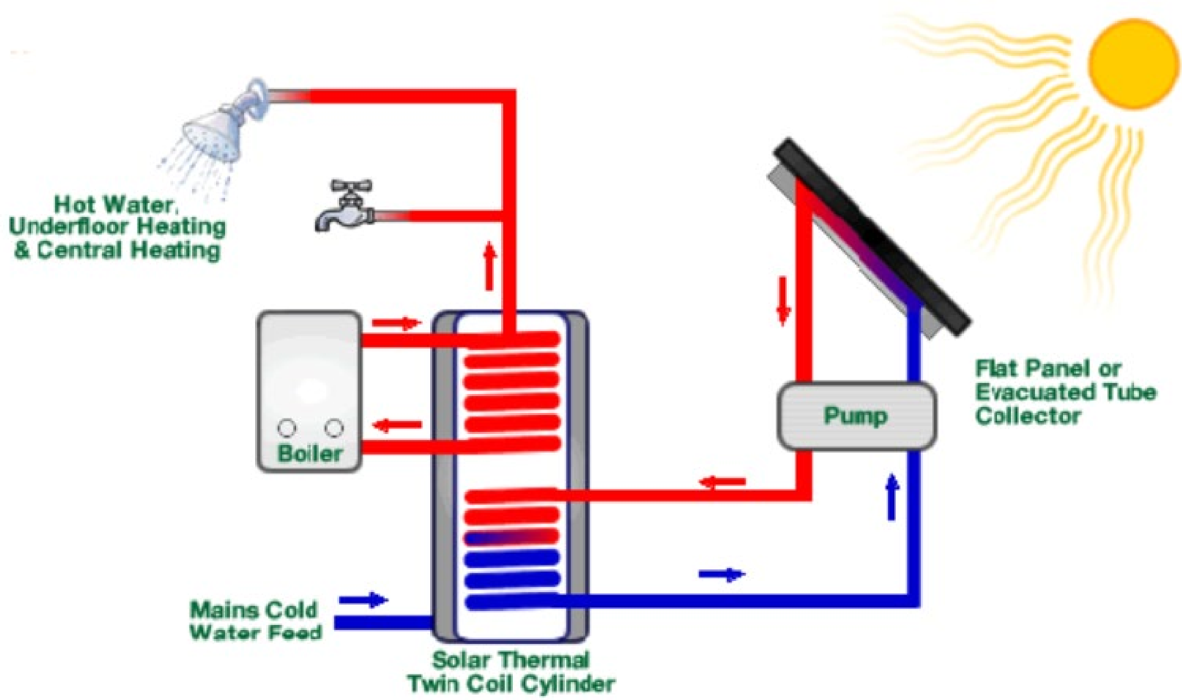
Combined heat and power (CHP) is a process involving simultaneous generation of heat and electricity, where the heat generated in the process in harnessed via heat recovery equipment. CHP at the large commercial size is now fairly common in premises which have a simultaneous demand for heating and electricity for long periods, such as hospitals, recreational centres and hotels. In addition, small CHP systems are now becoming available for individual houses, group residential units and small non-domestic premises. Compared with using centrally generated electricity supplied via the grid, CHP can offer a more efficient and economic method of supplying energy demand, if installed and operated appropriately, owing to the utilization of heat which is normally rejected to the atmosphere from central generating stations, and by reducing network distribution losses due to local generation and use.

Heat generated will be used for space and water heating, and additional heat storage may be used to lengthen use periods, to assist in warm-up and to improve overall energy efficiency. For overall good energy efficiency, as with all CHP, usage must be heat demand led. Thus, a sophisticated control system is required and users should be made aware of efficient operating practices.



## Solar thermal collectors

Solar thermal collectors (flat plate or evacuated tubes) convert solar thermal energy into heat for hot water generation. These are usually located on a roof oriented south facing in an ideal slope of 45 degree. Solar collectors properly sized and designed provide approx 50% of annual hot water demand.



## Photovoltaic

Photovoltaic modules convert sunlight directly into DC electricity and can be integrated into buildings. Photovoltaics (PVs) are distinct from other renewable energy technologies since they have no moving parts to be maintained and are silent. PV systems can be incorporated into buildings in various ways: on sloped roofs and fl at roofs, in façades, atria and shading devices. Modules can be mounted using frames or they can be fully incorporated into the actual building fabric; for example, PV roof tiles are now available which can be fitted in place of standard tiles.

Currently, a PV system will cost between £1500 and £2500 per kWp, and frequently part of this cost can be offset owing to the displacement of a conventional cladding material. Costs have fallen significantly since the first systems were installed (1980s) and are predicted to fall further still.

While single crystal silicon remains the most efficient flat plate technology (15–16% conversion efficiency); it also has the least potential for cost reduction. PV cells made from poly-crystalline silicon have become popular as they are less expensive to produce, although they have a slightly lower efficiency.

Thin film modules are constructed by depositing extremely thin layers of photosensitive materials on a low-cost backing such as glass, stainless steel or plastic. As much less semiconductor material is required as for crystalline silicon cells, material costs are potentially much lower. Efficiencies are much lower, around 4–5%, although this can be boosted to 8–10% by depositing two or three layers of thin film material. Thin film production also requires less handling as the films are produced as large, complete modules and not as individual cells that have to be mounted in frames and wired together. Hence, there is the potential for significant cost reductions with volume production.

Since PVs generate DC output, an inverter and other equipment is needed to deliver the power to a building or the grid in an acceptable AC form. The cost of the inverter and these 'Balance of System' (BOS) components can approach 30% of the total cost of a PV system. Hence, simplification and cost reductions in these components over the coming years will also be necessary to make PV systems affordable.

## Wind energy

Wind power is the most successful and fastest spreading renewable energy technology in the UK with a number of individual and group installations of varying size, capacity and location. Traditionally, turbines are installed in non-urban areas with a strong trend for large offshore wind farms. In parallel with the design and development of ever-bigger machines, which are deemed to be more efficient and cost-effective, it is being increasingly recognized that smaller devices installed at the point of use, i.e. urban settings, can play an important role in reducing carbon emissions if they become mainstream.

At present there is a wide range of available off-the-shelf wind products, many manufactured in the UK and EU with proven good performance and durability. The dominant type is horizontal axis wind turbines (HAWT), which are typically ground mounted. Vertical axis wind turbines (VAWT) have limited market presence and there is a trade-off between lower efficiency and potentially higher resistance to extreme conditions. Capacity ranges from 500W to more than 1.5MW, but, for practical purposes and in built-up areas in particular, machines of more than 1kW and below 500kW are likely to be considered.
Wind technology is also currently one of the most cost-effective renewable energy technologies, which is attributable to the large scale of installations reducing the unit output cost. Individual building or community wind projects, although smaller, have the advantage of feeding electricity directly into the building's electricity circuit, thus sparing costly distribution network development and avoiding distribution losses. The downside is the still high capital cost per kW installed for smaller turbines, plus location constraints, such as visual intrusion and noise. The wind regime in urban areas is also a concern owing to higher wind turbulence which reduces the potential electricity output.

In most cases, wind turbines are connected to the electricity grid and all generated energy is used regardless of the building demand fluctuations. The output largely depends on the wind speed and the correlation between the two is a cube function. This means that in short periods of above-average wind speeds the generation increases exponentially. As a result, it is difficult to make precise calculations of the annual output of a turbine, but average figures can provide useful guidance to designers and architects. In reasonably windy areas (average wind speed of 6m/s) the expected output from 1kW installed is about 2500kWh annually.

The cost per kW installed varies considerably by manufacturer and size of machine with an indicative bracket of £2,500–£5,000. With a lifespan of more than 20 years, wind turbines can save money if design and planning are carried out in a robust way.

Building-integrated wind turbines are starting to be a reality in the UK, but potential projects may face difficulties with obtaining planning permission. There are a few examples now of permitted development rights for certain rooftop turbines in some local councils. A number of horizontal axis devices specifically designed for building integration are now available commercially, having design and reliability parameters relevant to the urban context. Building-mounted vertical axis devices are under development. At present, turbines installed near buildings, as well as community installations for groups of buildings, should be regarded as the larger wind energy source related to buildings, when they contribute to the carbon emissions from these premises using 'private wire' networks. However, the contribution of several building-integrated turbines in a development is likely to become significant in the next few years.

# Appendix B-Fuel prices and emission factors

| | Standing Charge £ | Unit Price p/kWh | Emission Kg CO2 p/kWh | PE Factor | Fuel Code |
|---|---|---|---|---|---|
| **Gas fuels:** | | | | | |
| mains gas | 92 | 3.64 | 0.210 | 1.130 | 1 |
| bulk LPG | 62 | 6.74 | 0.241 | 1.141 | 2 |
| bottled LPG (for main heating system) | | 9.46 | 0.241 | 1.141 | 3 |
| bottled LPG (for secondary heating) | | 11.20 | 0.241 | 1.133 | 5 |
| LPG subject to Special Condition 11F (a) | 92 | 3.64 | 0.241 | 1.163 | 9 |
| biogas (including anaerobic digestion) | 62 | 6.74 | 0.024 | 1.286 | 7 |
| **Liquid fuels:** | | | | | |
| heating oil | | 4.94 | 0.298 | 1.180 | 4 |
| bio-liquid HVO from used cooking oil (d) | | 6.79 | 0.036 | 1.180 | 71 |
| bio-liquid FAME from animal/vegetable oils (e) | | 6.79 | 0.018 | 1.180 | 73 |
| B30K (0 | | 5.49 | 0.214 | 1.136 | 75 |
| bioethanol from any biomass source | | 47 | 0.105 | 1.472 | 76 |
| **Solid fuels:** (g) | | | | | |
| house coal | | 5.58 | 0.395 | 1.064 | 11 |
| anthracite | | 4.19 | 0.395 | 1.064 | 15 |
| manufactured smokeless fuel | | 5.91 | 0.366 | 1.261 | 12 |
| wood logs | | 5.12 | 0.028 | 1.046 | 20 |
| wood pellets (in bags for secondary heating) | | 6.91 | 0.053 | 1.325 | 22 |
| wood pellets (bulk supply for main heating) | | 6.25 | 0.053 | 1.325 | 23 |
| wood chips | | 3.72 | 0.023 | 1.046 | 21 |
| dual fuel appliance (mineral and wood) | | 4.77 | 0.087 | 1.049 | 10 |
| **Electricity:** (a) | | | | | |
| standard tariff | 81 30 | 16.49 | 0.136 (s) | 1.5010t) | |
| 7-hour tariff (high rate) (h) | 7 32 | 19.60 | 0.136 (s) | 1.5010t) | |
| 7-hour tariff (low rate) (h) | | 9.40 31 | 0.136 (s) | 1.501 (t) | |
| 10-hour tariff (high rate) ("> | 21 34 | 20.54 | 0.136 (s) | 1.501 (t) | |
| 10-hour tariff (low rate) fib) | | 12.27 33 | 0.136 (a) | 1.501 (0 | |
| 18-hour tariff (high rate) ("> | 26 38 | 17.41 | 0.136 (s) | 1.501 (0 | |
| 18-hour tariff (low rate) 00 | | 14.17 40 | 0.136 (s) | 1.501 (t) | |
| 24-hour heating tariff | 26 35 | 14.04 | 0.136 (s) | 1.501 0) | |
| electricity sold to grid, PV | | 5.59 (0 60 | 0.136 (s) | 0.501 0) | |
| electricity sold to grid, other | | 5.59 () 36 | 0.136 (s) | 0.501 0) | |
| electricity, any tariff 0) | | N/A 39 | 0.136 (s) | 1.501 0t) | |
| **Heat networks:** (k) | 92 0) | | | | |
| heat from boilers - mains gas | | 4.44 51 | 0.210 | 1.130 | |
| heat from boilers - LPG | | 4.44 52 | 0.241 | 1.141 | |
| heat from boilers - oil (assumes 'gas oil') | | 4.44 53 | 0.335 | 1.180 | |
| heat from boilers that can use mineral oil or biodiesel | | 4.44 56 | 0.335 | 1.180 | |
| heat from boilers using HVO from used cooking oil | | 4.44 | 0.036 | 1.180 | |

| | | | |
|---|---|---|---|
| | 57 | | |
| heat from boilers FAME from animal/vegetable oils (a) | 4.44<br>58 | 0.018 | 1.180 |
| heat from boilers - B30D 0) | 4.44<br>55 | 0.269 | 1.090 |
| heat from boilers - coal | 4.44<br>54 | 0.375 | 1.064 |
| heat from electric heat pump | 4.44<br>41 | 0.136 (s) | 1.501 0) |
| heat recovered from waste combustion | 4.44<br>42 | 0.015 0') | 0.063 |
| heat from boilers - biomass | 4.44<br>43 | 0.029 | 1.037 |
| heat from boilers - biogas (landfill or sewage gas) | 4.44<br>44 | 0.024 | 1.286 |
| heat recovered from power station | 3.77<br>45 | 0.015 0') | 0.063 |
| high grade heat recovered from process (Appendix C4.3) | 3.77<br>47 | 0.011 | 0.051 |
| low grade heat recovered from process (Appendix C4.4) | 3.77<br>49 | 0.136 001) | 1.501 (001) |
| heat recovered from geothermal or other natural processes | 3.77<br>46 | 0.011 | 0.051 |
| heat from **CHP** | 3.77<br>48 | as above0D | as above0D |

# Appendix C, D, E, and F

This appendix contains the following reports used in producing the content of this Energy and Sustainability Statement.

*Appendix C-* Flood risk map for planning to show the location of the site with regards to the relevant flood zone areas.

*Appendix D-* SAP calculation reports for the selected units that were used to base the calculations on for this report. (All hierarchy steps)

*Appendix E*- Floor Plans and Elevations used for the SAP Calculations

*Appendix F*- Sample Water Calculations

# Flood map for planning

| Your reference | Location (easting/northing) | Created |
| --- | --- | --- |
| **<Unspecified>** | **455151/203173** | **11 Oct 2023 14:43** |

**Your selected location is in flood zone 1, an area with a low probability of flooding.**

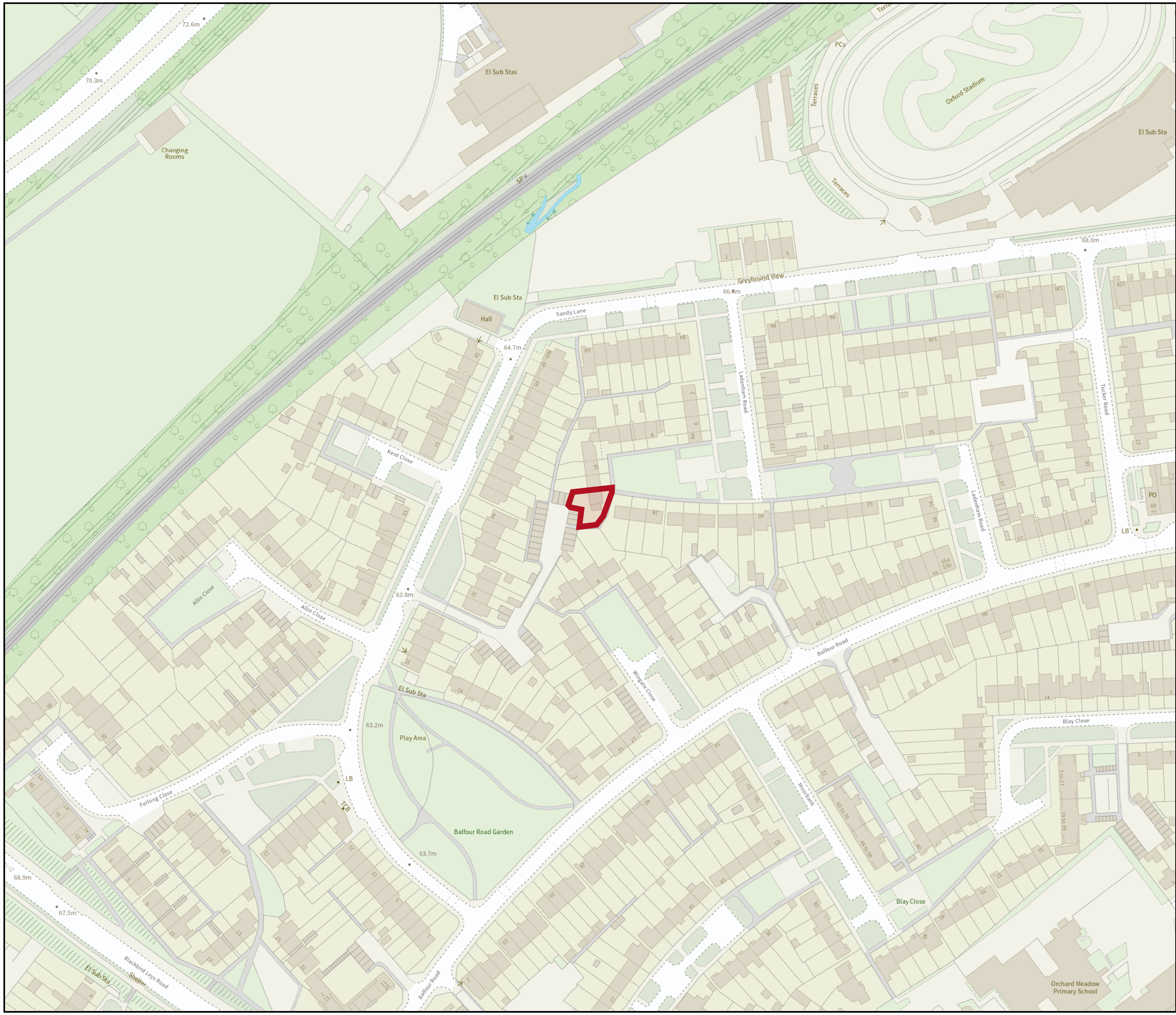
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

**Notes**

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.




Environment Agency

# Flood map for planning

Your reference
**<Unspecified>**

Location (easting/northing)
**455151/203173**

Scale
**1:2500**

Created
**11 Oct 2023 14:43**

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 20 40 60m

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]


NT: architect

t: 07855 978389
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rev:

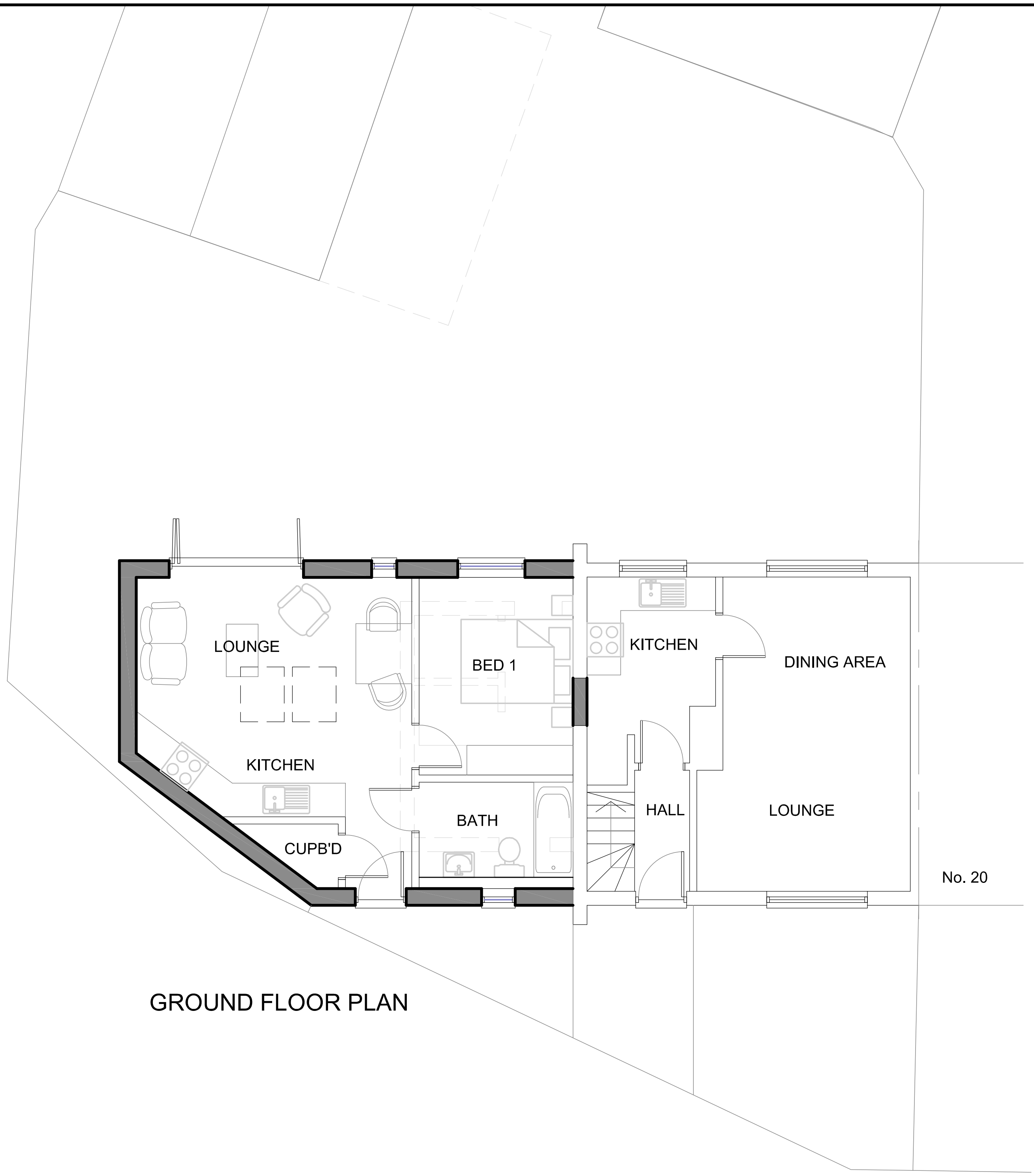
client:
MR. R. GASHI

22 LADENHAM ROAD
OXFORD
OXON. OX4 6AZ

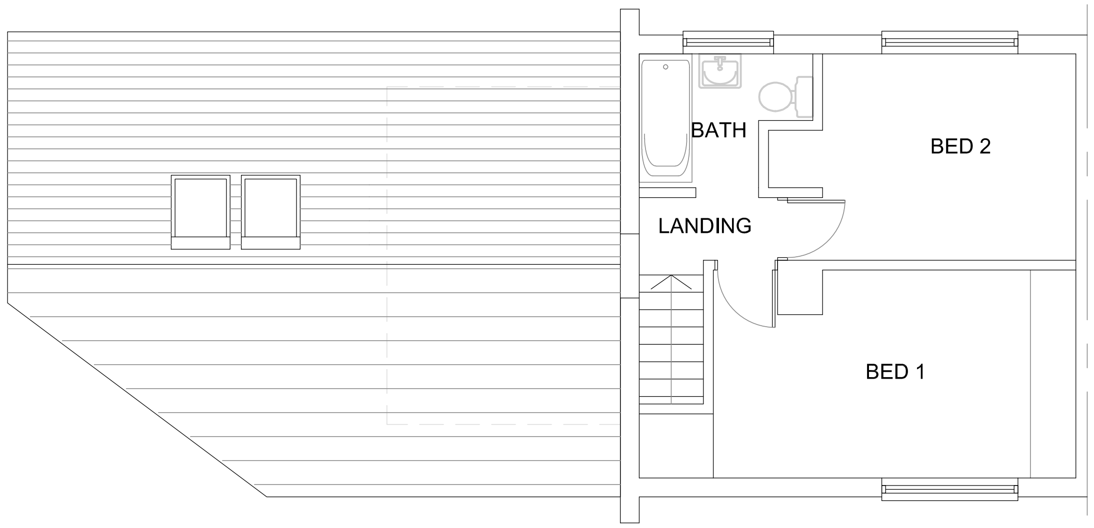
project:
PROPOSED SIDE EXTENSION TO HOUSE TO CREATE 1 x 1 BED FLAT

drawing:
PROPOSED:
SITE PLAN

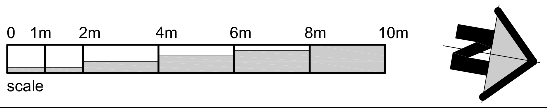
date: SEP 23
drawn: NT
scale: 1:200@A3
drawing no.: 23.63 - P1.02
rev:




GROUND FLOOR PLAN




FIRST FLOOR PLAN




**NT: architect**

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rev:

client:
MR. L. GASHI

22 LADENHAM ROAD
OXFORD
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project:
PROPOSED SIDE EXTENSION TO HOUSE TO CREATE 1 x 1 BED FLAT

drawing:
PROPOSED:
FLOOR PLANS

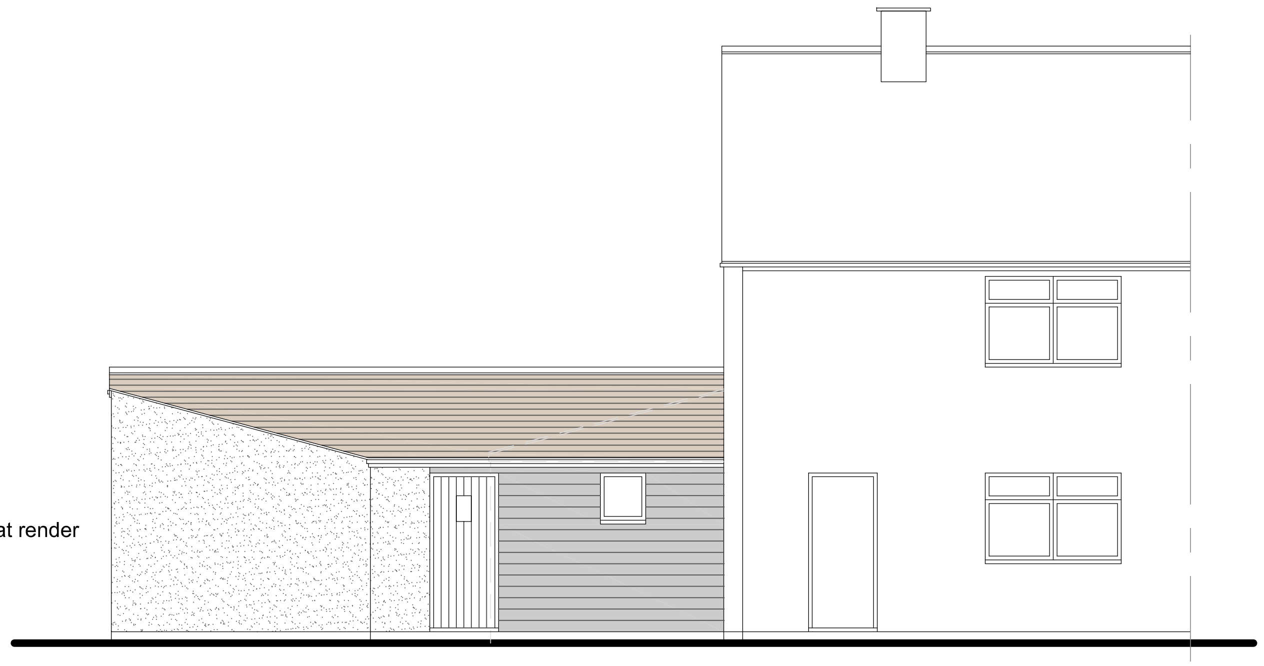
date:
SEP 23

drawn:
NT

scale:
1:100@A3

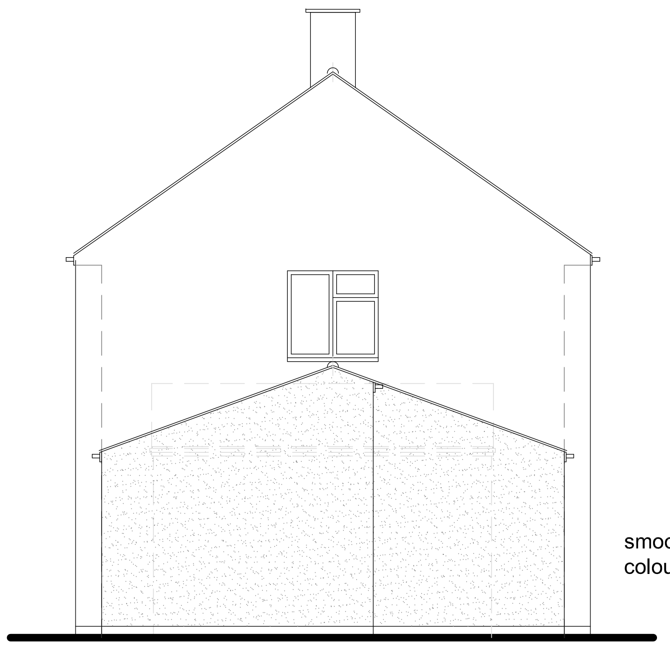
drawing no.:
23.63 - SK2.01

rev:

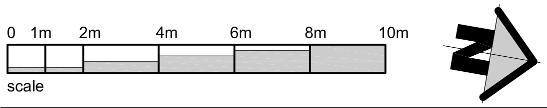



FRONT ELEVATION


REAR ELEVATION




SIDE ELEVATION

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project:
PROPOSED SIDE EXTENSION TO HOUSE TO CREATE 1 x 1 BED FLAT

drawing:
PROPOSED:
ELEVATIONS

date: SEP 23
drawn: NT
scale: 1:100@A3
drawing no.: 23.63 - SK2.02
rev:

breglobal

| | |
|---|---|
| Job no: | PR11065 |
| Date: | 12/10/2023 |
| Assessor name: | Iraj Maghounaki |
| Registration no: | BRE400012 |
| Development name: | Appendix F Sample |



**PRINTING:** before printing please make sure that in "Page Setup" you have selected the page to be as "Landscape" and that the Scale has been set up to 70% (maximum)

## WATER EFFICIENCY CALCULATOR FOR NEW DWELLINGS - (BASIC CALCULATOR)

| | House Type: | Type 1 | | Type 2 | | Type 3 | | Type 4 | | Type 5 | | Type 6 | | Type 7 | | Type 8 | | Type 9 | | Type 10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Description: | Sample | | | | | | | | | | | | | | | | | | | |
| Installation Type | Unit of measure | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day | Capacity/ flow rate | Litres/ person/ day |
| Is a dual or single flush WC specified? | | Dual | | | | | | | | | | | | | | | | | | | |
| WC | Full flush volume | 6 | 8.76 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| | Part flush volume | 3 | 8.88 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Taps (excluding kitchen and external taps) | Flow rate (litres / minute) | 6 | 11.06 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Are both a Bath & Shower Present? | | Bath & Shower | | | | | | | | | | | | | | | | | | | |
| Bath | Capacity to overflow | 155 | 17.05 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Shower | Flow rate (litres / minute) | 8 | 34.96 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Kitchen sink taps | Flow rate (litres / minute) | 6 | 13.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Has a washing machine been specified? | | No | | | | | | | | | | | | | | | | | | | |
| Washing Machine | Litres / kg | 12 | 17.16 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Has a dishwasher been specified? | | No | | | | | | | | | | | | | | | | | | | |
| Dishwasher | Litres / place setting | 0.9 | 4.50 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Has a waste disposal unit been specified? | | No | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Water Softener | Litres / person / day | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 | | 0.00 |
| Calculated Use | | | 115.4 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 | | 0.0 |
| Normalisation factor | | | 0.91 | | 0.91 | | 0.91 | | 0.91 | | 0.91 | | 0.91 | | 0.91 | | 0.91 | | 0.91 | | 0.91 |
| Code for Sustainable Homes | Total Consumption | | **105.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** |
| | Mandatory level | | **Level 3/4** | | - | | - | | - | | - | | - | | - | | - | | - | | - |
| Building Regulations 17.K | External use | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 | | 5.0 |
| | Total Consumption | | **110.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** | | **0.0** |
| | 17.K Compliance? | | **Yes** | | - | | - | | - | | - | | - | | - | | - | | - | | - |