Energy Statement for Grimshaw Lane, Manchester, M40 2AX

Development Energy Statement

Document Reference:
20006.R.001

19th October 2020

REVISION	DATE	DESCRIPTION	PREPARED BY	CHECKED
DRAFT	19.10.20	First draft for comment	SWH	AB
Rev A	30.10.20	Update for Usage Classification	SWH	AB
Rev B	09.02.21	Site layout increased and updated	SWH	AB

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1. Executive Summary

This report has been prepared to accompany the planning application for the construction of twelve industrial warehouse units with associated office space.

A base specification, detailed in Appendix A, was used to inform the energy model of the development. Throughout this report, various measures are considered to explore how energy use and subsequent carbon emissions could be reduced. Calculations are based on the old B1 Planning class which has recently been replaced by Class E(g).

The energy targets are as follows:

- Compliance with Part L Building Regulations
- Minimum EPC rating of B (Rating between 0-50)

Additional measures have also been considered throughout this review:

- Building fabric
- Services
- CHP & district heating
- Renewable energies
- Design factors

The base specification detailed in Appendix A was produced to demonstrate that the development meets Part L Building Regulations. The additional energy efficiency and saving measures detailed below have been reviewed and the findings are detailed throughout this report to demonstrate the significance of improvement on the baseline model. A summary of the findings following a review of potential additional measures considered is provided below:

- Generally, improvements to the fabric did not produce significant energy savings.
- Alterations to building services indicated the capability of producing larger reductions, but still not significant.
- The results suggest that use of the roof lights, efficient lighting, and lighting controls are important in this type development to limit energy consumption.
- Renewable energy options were explored, and solar PV arrays were found to be the most viable option. This type of technology can cost effectively produce significant reductions. If the PV arrays are maximised on a unit then it could be possible to achieve a 20% reduction energy use and subsequent carbon emissions. However, the effectiveness of the base specification is such that the energy targets can be achieved without the need for installing solar PV.

Overall, the proposed baseline specification, as shown in Appendix A, achieves good levels of performance. The development exceeds the Part L Building Regulation standards and all the units comfortably achieve an EPC rating of A. Detailed results are given in Appendix B.

2. Introduction

This report has been prepared to accompany the planning application for the redevelopment of the site at Grimshaw Lane, Manchester and the construction of twelve new commercial warehouse units with associated office space.

The report presents the outcome of a review of the areas of construction and services affecting the energy use and carbon emissions of the development and presents the benefits of potential improvements/amendments to a base level of specification.

The key issues covered in this report are:

- Energy use and carbon emissions
- Passive design factors

The most effective way to improve the energy efficiency of buildings is to follow the simple three stage energy hierarchy: Be Lean, Be Clean, and Be Green, which is explained in more detail in section 4 of this report.

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3. The Proposed Development

The proposals include for the construction of twelve new industrial warehouse buildings with associated office space. The remainder of the site has access, service yard, and carparking amenities. The new development replaces an existing group of industrial units.

Calculations are based on the old B1 Planning use class which has recently been replaced by Class E(g).

4. Energy Use

The energy use and carbon emissions have been estimated based on energy models using iSBEM energy modelling software.

There is a three-stage energy hierarchy to producing low carbon emissions:

- Be Lean: Design to use less energy through specifying a high standard of insulation, reducing ventilation loss, installing efficient services for space and water heating, cooling, and ventilation, as well as installing energy efficient lighting. The design of the building can be used to achieve passive gains in energy reduction through the shape, orientation, shading, window size, and orientation.
- Be Clean: Seek to supply energy efficiently through the use of district heating systems or the use of Combined Heat and Power.
- Be Green: Specify renewable energy; solar thermal panels, wind turbines, heat source pumps, biomass, and solar PV arrays.

We have looked at a baseline specification and the energy use and carbon emissions achievable. See Appendix A for the outline specification.

The baseline fabric standards exceed the requirements of the limiting U Values in Part L of the Building Regulations, and mostly perform worse than the standard used in the calculation of the Target Emission Rate (TER). The table below illustrates how the proposed fabric compares to Part L and the TER.

Table 1 – Proposed fabric standards compared with Part L Building Regulations

Element	Proposed	Limiting U Values Part L1A 2010 & Part L1A 2013	U Values used in Part L1A 2013 TER
Floor	0.23	0.25	0.13
Wall	0.20	0.30	0.18
Roof	0.15	0.20	0.13
Window	1.50	2.0	1.40
Door	1.50	2.0	1.20
Air permeability	3	10.0	5 m^3/m^2hr

Although the proposed specification does not always achieve the TER standards, overall, the buildings with this specification show compliance with the Part L requirements. This is because in this type of development the building services, and in particular the lighting, are the most significant energy use and therefore provide the greatest opportunities for energy efficiency improvements. The base specification maximises the benefits of efficient lighting and controls.

It is estimated that the specification in Appendix A will produce:

- 26% reduction in energy use over those of Part L 2013.
- 16.6% reduction in carbon emissions over those of Part L 2013.
- Average Energy rating of 17 (Band A)

5. Options for Improvement – Fabric Energy Reduction

The premise is that the office spaces are the only areas that will be heated/cooled, therefore the energy use for space heating applies only to these areas. The warehouse/workshop areas are understood to be untreated for Part L purposes.

5.1. Floors

- The base level specification for floor insulation used is 50mm PIR. Heat loss through the floors is relatively low.
- Doubling the insulation would result in minimal energy reduction and is not feasible.

5.2. Walls

- The base level specification uses a U value of 0.20 for the external wall, based on a built-up cladding/mineral wool construction. The wall between the heated offices and the unheated warehouse/workshop areas are assumed as a light steel frame and mineral wool insulation to achieve a similar U value.
- Large improvements in wall insulation do not result in large energy reductions for the development.

5.3. Roofs

- The base level insulation provides a good U Value standard. The insulation levels for the roofs of the conditioned areas are key, as these are located within the overall unheated warehouse spaces.
- As the warehouse space also has an insulated envelope, additional insulation to the roof areas results in a small reduction of the overall energy use.

5.4. Doors

- The area of doors in relation to exposed heat loss areas is relatively small. There are only the entrance doors between the heated office and external, and an allowance for doors between the unheated warehouse/workshop areas and the office.
- Doors therefore have an insignificant impact on the building's energy use.

5.5. Windows

- The windows, within the wall and roof, have two benefits in that they let in light and thereby reduce the requirement for electric lighting, and they can also produce solar gains to reduce the space heating requirement. They have the dis-benefits of having a worse U Value than the walls or roof and the solar gains can add to the overheating risk within the space.
- In the baseline specification we have allowed for a U value of 1.50.
- A large improvement to the window U value will have a very small impact on reducing the overall energy use, at about 1.0%.
- Reducing the area of rooflights will have a significant disbenefit to the energy use.

5.6. Air permeability

- The base line specification assumes the office areas are to be tested and achieve a maximum result of 3 m^3/m^2hr.
- The target level of the air permeability is already a good and lowering this target rate will have very little effect on the developments' energy use.

5.7. Thermal bridges

- Within the baseline specification we have assumed that the metal cladding would be constructed to thermal bridging standards equivalent to the MCRAS standard details. If this were not the case and default cladding thermal bridging standards were used, there would be an increase in carbon emissions and energy use by about 15%. If the MCRAS recommended standards are used, the carbon emissions are likely to reduce by around 3%.
- This therefore an important element in the design.

6. Options for Improvement – Services Options

6.1. Lighting

- It has been assumed that there will be a reasonably good standard of lighting throughout the building, based on the use of LED lamps which have a high LOR (light output ratio), and a high efficiency. In the base specification we have anticipated an efficiency of 115 lm/Watt for the warehouse/workshop, and 100 lm/W for the office areas.
- It is possible to cost effectively increase these levels of efficiency to 130 lm/W for the warehouse/workshop, and 110 lm/W for the office areas.
- With these levels of efficiency, it is anticipated that there would be a reduction in carbon emissions and energy use of about 5.0%.

6.2. Space heating /cooling

- The smaller units (numbers A-F) are heated using a gas fired boiler system and radiators; we have assumed a seasonal efficiency for the boilers of 95%.

- The larger units (numbers 1-6) have a VRF/ a split system with EER for the space heating and cooling of 3.0 and 3.5.
- The design of such systems is improving all the time and better seasonal effectiveness should be possible with a relatively small additional cost.

6.3. Meter for "out of range" values

- Additional energy metering and monitoring through the installation of a BEM system could result in reduced energy consumption. The system works by monitoring and tracking energy usage and raising an alarm where abnormal energy usage is identified.
- With such metering, it is estimated that there could be a reduction in carbon emissions and energy use reduction of about 1.4%.

6.4. Minimising Energy use

- In addition to the measures outlined above, clear instructions on how best to use a building is also a proven method to improving energy efficiency, e.g. through control systems and energy management systems. The savings indicated above could be rendered useless if the new tenants do not use the systems effectively. Therefore, the production of good operation manuals is important in the efficient running of the building and its services.

7. CHP and district heating

Carbon savings can be achieved with efficient sourcing of energy. Typically, through the use of CHP or linking into existing district heating systems.

A CHP system is one where there is simultaneous generation of heat and power. The CHP unit acts as a boiler in producing a heated primary circuit and also generates electrical power. The use of CHP, although generating electricity, is not considered an onsite renewable source unless fuelled by biomass. A CHP unit runs economically when there is a consistent annual load. In this case the units do not have high space heating loads and have low hot water demand. This results in variable annual heat demands, which is not suitable for CHP use. Therefore, this technology is not suitable.

It is understood that there are no existing district heating schemes that the buildings can be connected to. This technology is therefore considered unviable for the proposed development

8. Renewable Options

The following renewable energy technologies are considered below:

- Wind generators
- Photovoltaics
- Solar water heating
- Heat Pumps
- Biomass heating

8.1. Wind Generators

- The economics of wind are driven by two factors: wind flow and rotor diameter, with economies of scale acting strongly in favour of turbines with a capacity of greater than 1MW. Micro-wind is defined as units of less than 4m diameter, having an output of up to 3.5kW.
- Another performance factor, particularly relevant to micro wind power is quality of wind flow. Poor wind flow can have a detrimental effect on output levels, efficiency, and unit longevity. Poor wind quality is often experienced in urban locations, where neighbouring buildings disrupt turbine operation. The height of the turbine installation relative to neighbouring buildings will help to determine efficiency – ideally, they should be 9m above other obstructions within 100m. It is important to have a detailed survey of the proposed site before proceeding with a wind turbine. Even then small changes in location can have a large effect on the output of the turbine.
- A further disadvantage with wind turbines is noise generation, although this is not a great issue in this location.
- The average wind speed on this site using the Rensmart Wind Energy calculation tool is approx 5.3 m/s at 10m above the ridge height. This is low and makes the viable use of a turbine less possible.
- Due to the reasons outlined above, wind generators are not considered a viable technology for this development.

8.2. Photovoltaics

- Photovoltaic systems convert energy from the sun into electricity through semiconductor cells mounted in collector panels. The panels are connected to an inverter to turn the DC output into AC for use in the building to which they are attached and to be fed back into the grid when not required.
- Any power generated by the PV panels has a proportionally high saving in terms of CO_2, as the fuel saved is electricity, which is a carbon dense fuel.
- However, this country is increasing the proportion of renewable generated electricity in mains power and it is intended that over the coming years mains electricity will have a much lower carbon density. In the first quarter of 2020 renewables accounted for about 47% of UK generated electricity. This compares to a proportion of 3.3% in 2010. These figures would suggest that the benefits of PVs will become less about carbon emission reduction and more about the reduction in running costs.
- Generally, PV panels will produce more electricity during the day than is used in building. Therefore, typically a majority percentage of the generated electricity will be exported. In order to achieve running cost savings, one must find an energy supplier who will purchase this generated electricity. Currently the amount paid for this electricity is quite low sometimes, around 3p/kWh.
- Outputs are usually measured in Kilowatt Peak (kWp). This is the max kWh that the panel could produce under perfect conditions. The cost of PV panels varies according to the amount purchased. For arrays of between 1.0 - 10 kWp an average cost would be £1,500 - £2,200 per kWp depending on the amount installed. The more panels installed the cheaper the £/kWP cost.

Table 2 – PV outputs

Orientation of PV panels	kWh/kWp	$kgCO_2/kWp$
Sloping roof South 30 deg	858	454
Sloping roof South east 42 deg	798	422
Sloping roof East / west 30 deg	730.40	386
Flat roof South horizontal	760.5	398

- This development has substantial available roof space on each unit. The pitch is low and therefore would count effectively as a horizontal installation, and as such will be relatively unaffected by the orientation of the pitch
- There are large areas of rooflights, and any PV array would have to be set between these rooflights. As the use of rooflights significantly benefits the energy use of the development, the rooflights should be preferential to any PV.
- Each unit will have the ability to support different amounts of PV.
- The kWp of a panel depends on the area and type of panel construction. There is a wide range of panels available, that can deliver 1 kWp from a panel area of $5m^2$ - to 10 m^2.
- A 5 kWp array would generate about 3,760 kwh/yr, and about 1,900 $kg/CO_2/yr$.
- Usually PV arrays can repay their cost under a simple repayment calculation in about 15-18 years and in some cases, sooner.

8.3. Solar Water heating

- Solar water heating systems use the energy from the sun to heat water stored in a hot water cylinder inside the building. The amount of savings from solar thermal is determined by the level of hot water use.
- The roof area available for solar panels is the same as for PV. However, the area of panel required is determined by the hot water use. Depending on the type of panel; flat plate glazed or evacuated tube, there is an optimum area needed for the hot water use. Flat plate glazed panels tend to be less efficient but cheaper than the evacuated tubes. Most installations use the flat plate glazed panels.

- The hot water demand in these buildings is small, and so the savings in running costs and carbon emissions will also be small.
- Therefore, the simple payback will be in excess of 25 years, and beyond the systems expected life of 25 years.
- This technology is suitable for this scheme. However, as the panels do not provide a good economic return, this technology is not favourable for this development.

8.4. Ground Source Heat Pump

- Ground source heat pumps (GSHP) are used to extract heat from the ground to provide space and water heating. Heat pumps take in heat at a certain temperature and release it at a higher temperature, using the same process as a refrigerator. Fluid is circulated through pipes buried in the ground and pass through a heat exchanger in the heat pump that extracts heat from the fluid. The heat pump raises the temperature of the fluid via the compression cycle to supply hot water to the building as with a normal boiler. The ground pipe system can be horizontal or vertical. The system works most efficiently with underfloor heating.
- The pipe system is the key to the effectiveness of the GSHP. This can either be a "slinky" style pipe buried in trenches a couple of meters deep or in much deeper boreholes.
- As an alternative to gas, they are much more efficient, and use a lot less energy. However, as electricity is more carbon dense than gas there is not a similar reduction in carbon emissions over a gas fired system. As gas is about a third of the cost of electricity, even though less energy is used there is only a relatively small reduction in running costs over gas.
- GSHPs are more expensive to install than a traditional gas system.
- In this development it is likely that boreholes would be needed to run the heat pump. These would be considerably more expensive that a gas installation and potentially up to three times as expensive as an air source heat pump system.
- This technology is suitable for this scheme, but due to the installation costs we anticipate it will not be viable for this development.

8.5. Air Source Heat Pumps.

- An ASHP works in an identical way to a GSHP. The difference comes in achieving the temperature difference in the system fluids. The GSHP uses the difference in temperature found as you go deeper into the earth. An ASHP uses the difference in air temperatures. Typically, an ASHP is much less efficient than a GSHP.
- An ASHP is much cheaper to install than a GSHP as there are no ground works, although usually an external condenser unit must be sited on the building.
- It is proposed to use ASHP for the main areas of heating and cooling in the larger units.

8.6. Biomass boilers

- Biomass is a form of stored solar energy. Plants use the suns energy to grow and during this process absorb CO_2. When burnt the stored energy and stored CO_2 is released. Biomass fuels are considered virtually carbon neutral because unlike fuels such as gas, oil and coal, if not burnt the CO_2 would be released anyway as the plant material rotted. Therefore, there is no addition to CO_2 in the environment.
- Typical biomass fuels include wood, straw, energy crops, sewage, and waste materials. It is a proven technology and has been in use for many years, particularly in northern European countries. Biomass plants can vary from small manual fed systems, to large fully automatic systems. The most common is wood chips or pellets.
- Biomass boilers are much more common in large communal systems and are often designed to operate alongside back up gas boilers. Typically, the biomass boiler operating on the constant loads, such as hot water, with the back-up gas boilers which have faster reaction times to cope with the variable loads.
- Another key factor of these boilers is that a large fuel store is required. A store is usually sized according to the lorry that is to deliver the fuel, and to minimise the number of deliveries over the year. Therefore, access for large vehicles is required. There is also the need for higher levels of maintenance than there are with gas boilers
- Due principally to the poor economics and limited space for storage, as well as the consequent need for a chimney and related issues on air quality, this technology is considered to be unviable for this scheme.

9. Design aspects

9.1. Roof lights

- The warehouse areas are provided with rooflights equivalent to 10% of the floor area. These provide daylight and reduce the electric light requirement. If there were no roof lights, it is anticipated there would be a 25% increase in energy use.

9.2. Orientation

- The orientation of the buildings does not make a significant impact on the energy use. This is due to the relative proportion of glazing to the floor areas

10. Summary of Options

10.1. Fabric Options

- Of the fabric options (walls, floors, roofs, windows), the suggested measures all provide improvements to the energy use and running costs. However, it is anticipated that no individual measure has a significant effect. The use of rooflights significantly affects the energy use from lighting, which is the dominant energy use within this type of building.

10.2. Services options

- This type of development tends to be quite sensitive to lighting specification, and controls, so maximising these contributes significantly to efficiency.

10.3. Renewables

- The use of solar PV is the only real significant and viable option for renewables in terms of payback and ease of installation.
- The roof space varies on the units but would have to be situated between the rooflights.

10.4. Design factors

- Due to the combined benefit that roof lights provide; solar gains, daylight, and therefore the reduction of electric light requirement, it is beneficial to keep these within the design. If there were no roof lights, it is anticipated that there would be a significant increase in energy consumption, at around 30%.
- Aspects of orientation and siting of heated areas on party walls makes a relatively small contribution to savings, but generally speaking that are cost neutral.

11. Conclusions

The base specification provides a level of performance that means the development comfortably achieves the energy targets of compliance with Part L Building Regulations and an EPC rating in Band B.

Improvements to the specification do not result in large improvements to the reduction in energy use or energy rating.

The majority of energy use associated with this development is in lighting. The use of high efficiency lamps and lighting controls, plus the inclusion of roof lights, significantly improves the energy rating and reduces energy use.

Significant energy consumption reduction is expected as a result of metal cladding systems and the inclusion of good thermal bridging design.

Of the renewable options, only solar PV is understood to be feasible. However, the effectiveness of the base specification is such that the energy targets are achieved without the need for installed any PV.

Overall, the proposed baseline specification, as shown in Appendix A, achieves good levels of performance. The development exceeds the Part L Building Regulation standards and all the units comfortably achieve an EPC rating in Band A. See results in Appendix B.

The proposals fully comply with the energy targets and represent a good level of performance.

A. APPENDIX – Outline Specification

FABRIC

Element			U value	Construction	U value used in TER
Floor	11	Ground floor office circulation / toilets	0.20-0.25	Concrete slab with 50mm PIR insulation	0.13
	12	Ground floor warehouse unheated space	0.27	concrete – no insulation	
	13	Upper floor to offices over warehouse	0.15	Concrete plank floor with 250mm mineral wool below	
	14				
Walls	1	External wall	0.20	Built up Cladding system 13.5/3 Sinusoidal Profile Drg indicate about 180mm thick ins assume mineral wool	0.18
	2	Wall between office areas and unheated warehouse	0.24	2 num 100mm Metal studs with mineral wool insulation between (200mm overall thickness), plasterboard	
	3	Internal partitions	n/a	mix of stud and blockwork	
	4	Party wall conditioned	n/a	Meatal cladding wall	
	5	Party wall to unheated	0.35	Meal cladding wall	
Roof	21	Flat roof to unit	0.15	Cladding system 32/1000 forward profile; tata steel colour coat HSP200 Ultra Drg indicate about 240mm thick ins, assume mineral wool	0.13
	22	Roof to conditioned office space	0.14	Assumed this roof area does not have permanent access and so is not included as useable floor area Assumed 300mm mineral wool insulation	

Windows	Windows	1.50	All glass double glazed argon filled cavity soft coat low E coating – T solar- thermal – 0.36 L solar – light – 0.65	1.40
	Roof lights	1.30	Triple skin translucent roof lights	
Doors	Entrance	1.60	All glass double glazed argon filled cavity soft coat low E coating –	1.20

<table>
<tr><td></td><td>External fire door</td><td>1.60</td><td>Solid door</td><td></td></tr>
<tr><td></td><td>Loading door</td><td>1.50</td><td>Sectional door</td><td></td></tr>
<tr><td></td><td>Doors between office and unheated warehouse</td><td>1.60</td><td>Solid door</td><td></td></tr>
<tr><td>Thermal bridging</td><td>Manufacturer bridging standards</td><td colspan="2">All to Accredited Construction detail standards for masonry
Metal cladding roof system Based on Kingspan standard details, or MCRMA where not available
<table>
<tr><td>Junction</td><td>MCRMA
Psi values</td><td></td></tr>
<tr><td>Roof wall</td><td>0.02</td><td></td></tr>
<tr><td>Wall ground</td><td>0.75</td><td></td></tr>
<tr><td>Wall-wall corner (extl</td><td>0.02</td><td></td></tr>
<tr><td>Wall floor not ground</td><td>0.0</td><td></td></tr>
<tr><td>Lintel</td><td>0.05</td><td></td></tr>
<tr><td>Sill</td><td>0.05</td><td></td></tr>
<tr><td>Jamb</td><td>0.05</td><td></td></tr>
</table></td><td>ACD</td></tr>
<tr><td>Air permeability</td><td>m3/m2.hr</td><td>3.0</td><td>Air test to be carried out
Design target</td><td></td></tr>
<tr><td>Power Factor</td><td><0.90</td><td></td><td>Power factor default</td><td></td></tr>
</table>

SERVICES

Room	HVAC system	
Main storage	FROST PROTECTION ONLY	Not included in Part L
Offices units A - F	System 1	Low pressure Hot water system to radiators
Offices – units 1 - 6	System 2	VRF heating and cooling
Lobby / circulation – ground & 1st units A - F	System 1	Low pressure Hot water system to radiators
Toilets Disabled / male Female Ground floor & 1st floor units A – F	System 1	Low pressure Hot water system to radiators
Stairs units A – F	System 1	Low pressure Hot water system to radiators
Lobby / circulation – ground & 1st units 1 - 6	System 3	Electric panel
Toilets Disabled / male Female Ground floor & 1st floor	System 3	Electric panel

units 1 - 6		
Stairs units 1 to 6	System 3	Electric panel

Room	Ventilation	
Main storage	Natural	
offices	Natural	
Lobby / circulation – ground & 1st	Natural	
Toilets Disabled / male Female Ground floor & 1st floor	Intermittent extract	SFP=0.30
stairs	Natural	

HVAC	SYSTEM 1	
LPHW		
heating system	Low pressure Hot water system to radiators	
description	Mains Gas fired boiler and radiators	
Fuel proposed	Mains gas	
Manufacturer / model / model number of heating appliance	TBC	
Seasonal efficiency for system for heating	Seasonal efficiency of 95%	
Pump	variable	
Is HVAC separately metered?	yes	
M&T with alarms for 'out of range' values	No	
COOLING	none	
Controls	ASSUMED Central time control – yes Optimum Start/stop control – NO Local time control (room by room) – YES Local temperature control (room by room) – YES Weather compensation control - NO	

HVAC	SYSTEM 2	
VRF heating and cooling		
Heating system	ASHP	
Description	Split systems VRV / VRF	
Fuel proposed	electricity	
Manufacturer / model / model number of heating appliance	TBC	
Seasonal efficiency for system for heating	Heating Seasonal EER 3.0	
Pump	n/a	
Is HVAC separately metered?	yes	
M&T with alarms for 'out of range' values	No	
COOLING	Cooling Seasonal EER 3.5 or better. Cooling Nominal EER 3.5 or better.	
Controls	ASSUMED Central time control – yes Optimum Start/stop control – NO Local time control (room by room) – YES Local temperature control (room by room) – YES Weather compensation control - NO	

HVAC	SYSTEM 3	
Point heaters		
Heating system	Point heaters	
Description	Unfanned	
Fuel proposed	Electric	
Manufacturer / model / model number of heating appliance	Tbc	
Seasonal efficiency for system for heating	100%	
Pump	n/a	
Is HVAC separately metered?	Yes	
M&T with alarms for 'out of range' values	No	
COOLING	none	
Controls	ASSUMED Central time control – No Optimum Start/stop control – NO Local time control (room by room) – YES	

	Local temperature control (room by room) – YES Weather compensation control - NO	

	AREAS WITH NO HVAC SYSTEMS
Areas NOT heated	Main storage area - Provided with frost protection only

	HOT WATER SYSTEM 1
Areas provided	Toilets, kitchen, tea points
System type	electric instantaneous
Storage	none
Secondary circulation	n/a

LIGHTING		
Metering	Separately metered	yes
	M&T with alarm for 'out of range' values	no
Lamps	LowE lamps in all areas To be LED	
Display Lighting	none	

	LIGHTS							
Room	Lighting design Lux	Lighting design Watts	l/circ wat	LOR	Lamp type eg Flourescent-triphosphor coated Flourescent-halophosphor coated CFL; LED etc	Local manual	Daylight sensing photoelectric	Occupancy sensing / Auto on-off / Man on-off etc
Main storage			115	1.00	LED	Yes	Yes Parasitic power=0.1 W/m2	Yes Parasitic power=0.1 W/m2
Undercroft			100	1.00	LED		Yes Parasitic power=0.1 W/m2	Yes Parasitic power=0.1 W/m2
offices			100	1.00	LED	Yes	Yes Parasitic power=0.1 W/m2	Yes Parasitic power=0.1 W/m2
Lobby / circulation – ground & 1st			100	1.00	LED	yes	No	Yes Parasitic power=0.1 W/m2
Toilets Disabled / male Female Ground floor & 1st floor			100	1.00	LED	Yes	No	Yes Parasitic power=0.1 W/m2
stairs			100	1.00	LED	Yes	No	Yes Parasitic power=0.1 W/m2

RENEWABLES		
Photovoltaic (PV)		
Solar thermal panels	None	

B. APPENDIX - Results

The tables show the results for the

Actual - based on the specification in Appendix A

Notional – the baseline level related to Part L of the Building Regulations.

The results show:

- the energy use in kwh/m2/year

- the CO2 emissions in kg/CO2//m2/yr (which is the Building Emissions Rate (BER) and Target Emission Rate (TER) figures in Building Regulations Part L)

Whole development

	kwh/m2/yr											
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND	reduction in energy use
Actual	2.09	0.59	0.08	5.05	1.62	9.44	4.73	BER	-16.6%	17	A	-26.0%
Notional	2.45	0.39	0.09	7.94	1.88	12.75	5.68	TER				

Individual units

unit A

	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	13.01	0.00	0.71	8.27	1.65	23.65	8.33	BER	-19.8%	21	A
Notional	14.91	0.00	0.62	12.36	1.91	29.80	10.40	TER			

unit B

	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	12.37	0.00	0.73	8.47	1.64	23.21	8.30	BER	-18.2%	22	A
Notional	13.05	0.00	0.64	12.64	1.89	28.22	10.14	TER			

unit C

	kwh/m2/yr

	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	12.37	0.00	0.73	8.47	1.64	23.21	8.30	BER	-18.2%	22	A
Notional	13.05	0.00	0.64	12.64	1.89	28.22	10.14	TER			

unit D	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	12.64	0.00	0.69	8.18	1.68	23.19	8.20	BER	-21.6%	20	A
Notional	15.61	0.00	0.59	12.21	1.94	30.35	10.47	TER			

unit E	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	10.79	0.00	0.62	8.42	1.72	21.56	7.92	BER	-18.3%	20	A
Notional	11.53	0.00	0.51	12.47	1.99	26.50	9.69	TER			

unit F	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	7.89	0.00	0.44	7.14	1.71	17.17	6.52	BER	-18.3%	18	A
Notional	8.84	0.00	0.36	10.41	1.97	21.58	7.99	TER			

unit 1	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	1.78	0.62	0.08	5.53	1.68	9.68	5.02	BER	-15.0%	16	A
Notional	2.01	0.39	0.10	8.43	1.94	12.88	5.91	TER			

unit 2	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	2.43	0.72	0.11	5.84	1.67	10.78	5.60	BER	-13.8%	17	A
Notional	2.91	0.43	0.15	8.90	1.94	14.32	6.49	TER			

unit 3	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	2.11	0.79	0.08	5.81	1.68	10.47	5.43	BER	- 14.8%	17	A
Notional	2.82	0.41	0.11	8.82	1.95	14.11	6.38	TER			

unit 4	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	1.49	0.66	0.04	4.74	1.69	8.62	4.47	BER	- 17.8%	14	A
Notional	1.78	0.44	0.05	7.73	1.95	11.95	5.45	TER			

unit 5	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	1.56	0.57	0.04	4.74	1.67	8.60	4.46	BER	- 17.6%	14	A
Notional	1.93	0.39	0.06	7.66	1.94	11.97	5.42	TER			

unit 6	kwh/m2/yr										
	Heating	Cooling	Aux Energy	Lighting	Hot Water	Total	kg/ CO2/ m2/yr		% imp CO2	EPC RATING	epc BAND
Actual	2.00	0.67	0.06	5.65	1.69	10.08	5.23	BER	- 13.6%	16	A
Notional	2.10	0.51	0.08	8.57	1.96	13.22	6.05	TER			