Report No. 99804/R01
Date. October 2021

LYDHURST ESTATE

MECHANICAL AND ELECTRICAL SERVICES FEASIBILITY REPORT

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LYDHURST ESTATE

**MECHANICAL AND ELECTRICAL SERVICES
FEASIBILITY REPORT**

MTA Document No:		99804/R01	
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Rev	*Date*	*By*	*Summary of Changes*	*Chkd*	*Aprvd*

LYDHURST ESTATE

MECHANICAL AND ELECTRICAL SERVICES
FEASIBILITY REPORT

C O N T E N T S

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1. INTRODUCTION

Martin Thomas Associates have been commissioned to offer an appraisal of the primary energy options and infrastructure for the Walled Garden and Wellness Centre project at Lydhurst Estate, West Sussex.

This report and associated sketches have been produced as part of the RIBA Stage 2 Concept Design and should be read in conjunction with the Adam Richards Architects and vkhp-consulting Structural and Civil Engineering RIBA Stage 2 design information.

This report provides an overview of the existing site utilities and an options study for the possible primary heat sources available for the project. The report also covers the new incoming electricity and telecoms infrastructure and provides an overview of the necessary requirements for plant for providing heating, cooling and water.

Lydhurst Estate is located next to the village of Warninglid, West Sussex. The 222-acre estate is mostly made up of woodland, farmland and grassland, with a cluster of buildings in the north-east corner of the estate comprised of the principal house, Lydhurst House, and a number of cottages and estate buildings. A key feature of the estate is the walled garden, which is to form the centrepoint of the proposals covered in this report.

The project relates to the conversion of existing outbuildings into a restaurant, cookery school and wellness centre. Some of the buildings will be extended or replaced with similarly sized new buildings that are better suited for their purpose while remaining in keeping with the nature of the site. Additionally, a new build accommodation building known as the Dutch Barn is to be constructed to the northwest of the outbuildings.

The scope of this report does not cover the existing Lydhurst House or the proposed pool house and staff accommodation building mentioned in the Lydhurst Planning Document produced by Rural Solutions.

It is understood that none of the existing buildings are Listed, however the site is located within the High Weald Area of Outstanding Natural Beauty. The site is subject to the Mid Sussex Local Plan.

The existing site utilities include electricity to the majority of buildings and mains water to some buildings. Heat is currently generated using oil boilers. It is understood that there is no natural gas network in the area.

While there is no brief for using renewable or low carbon energy sources in this project, the aim will be to utilise these where suitable. The local development plan states that renewable energy sources should be used where appropriate and feasible. The feasibility of using various low carbon energy sources is covered in this report, along with fossil fuel options.

This report is based on information gathered from a site visit on 3rd August 2021, and information provided by the Client and Architect.

1.1 Project Overview

The project involves the conversion and replacement of several existing outbuildings to provide various experiences and activities to visitors to the Estate.

No existing mechanical and electrical services installations within the existing buildings will be retained.

The buildings included in the scope of this report are listed in the table below, along with their proposed uses:

Building Ref	Building Name	New Build / Existing
Building A	Cookery School	Proposed new build on existing building plot
Building B	Wellness Centre (Treatment Rooms)	Existing
Building C	Meeting Rooms / Offices	Existing
Building D	Arts & Crafts	Existing
Building E	Gym	Proposed new build on existing building plot
Building F	Yoga Studio	Existing, with new extension and connection to Gym
Building G	Machinery Shed / Plant Space	Existing
Building H	Staff Facilities	Existing
Building I	Restaurant, Reception, Club Room and Meeting Rooms	Existing, with new extension for Reception area
Building J	Dutch Barn	Proposed new build

Buildings A-F make up the proposed guest facilities offering a range of activities. Building G is to remain to be used for storage. Building H will be remodelled to serve as staff facilities. Building I will contain the restaurant and site reception, as well as meeting rooms and a ‘club room’ on the first floor. Building J will be a new guest accommodation building on the site of an existing Dutch Barn.

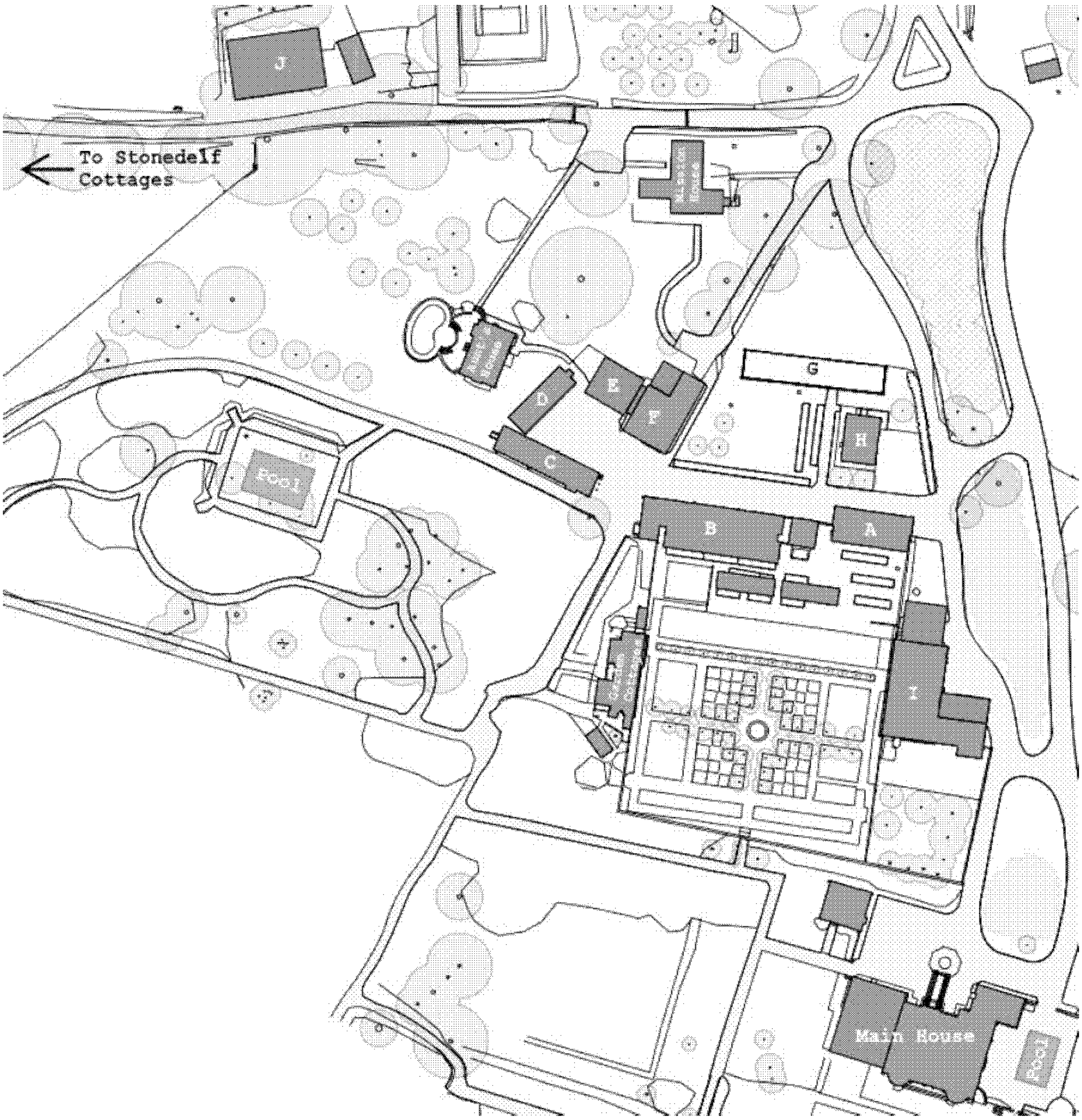
Additionally, the Main House (Lydhurst House), which in the long term is to be extended and refurbished is included in the scope for site-wide infrastructure, such as electrical supplies, water supplies and heating.

There are also plans for two new outdoor swimming pools, one located next to the Main House and another located to the west of the outbuildings. We currently have limited details on these proposals, so have made assumptions on their size and intended usage.

The following buildings are not in the scope for any new mechanical or electrical supplies or services:

Stonedelf Cottages
Gatehouses
Mission House

Aunt's House
Garden Cottages



Site plan (nts) showing buildings A-J, and other buildings including the Main House and the two proposed swimming pools

2. DESIGN CRITERIA / REPORT ASSUMPTIONS

To make an assessment of the required plant and utilities, we have based this report on the following design criteria. Where decisions have not yet been made or information has not been available, we have made assumptions based on our experience of similar projects.

2.1 General Assumptions

The following assumptions have been made where room layouts have yet to be developed or the M&E brief is yet to be confirmed.

Cookery School

- Hobs are to be LPG or electric (refer to electrical section)
- Cookery teaching space will be treated as a school classroom in terms of ventilation requirements (design will comply with BB101 guidelines)

Meeting Rooms

- It is understood that this building will not form part of the first stage of proposals, however, the building will be included when evaluating the feasibility of new site-wide infrastructure.

Arts & Crafts

- It is understood that this building will not form part of the first stage of proposals, however, the building will be included when evaluating the feasibility of new site-wide infrastructure.

Gym

- Space heating and comfort cooling is to be provided
- Assumed maximum occupancy of Gym is 15 people

Yoga Studio

- Assumed space heating is to be provided to comfort temperatures only - additional heating (e.g. for hot yoga) and cooling could also be provided if required, however is not currently proposed
- Assumed maximum occupancy of Yoga Studio is 20 people

Machinery Shed

- No new mechanical services to be provided

Restaurant & Reception

- Commercial kitchen assumed to use LPG or electric cooking (refer to electrical section)

- Assumed maximum occupancy of Restaurant is 70 people
- Assumed maximum occupancy of Club Room is 40 people

<u>Dutch Barn</u>

- Assumed occupancy of building is 12 people
- Assumed no cooling to be provided
- Ventilation assumed to be MVHR (but could be naturally ventilated by opening windows)

  It is assumed in this report that the Dutch Barn is considered as a single Dwelling in regards to the Building Regulations. It is assumed that the building will need to comply with Part L1A and therefore be subject to SAP calculations.

<u>Main House & New Swimming Pools</u>

- Swimming pools are assumed to be heated during summer only

2.2 Heating and Cooling

Winter design temperature:	-5°C (due to rural location) *(-4.1°C = 99.6% exceedance for Gatwick – ASHRAE design database)*	
Winter internal design temperatures: *(based on CIBSE Guide A comfort Criteria)*	Bedrooms	19-21°C
	Bathrooms	20-22°C
	Circulation	19-21°C
	Restaurant	21-23°C
	Commercial Kitchen	15-18°C
	Yoga Studio	19-21°C
	Gym	19-21°C
	Treatment Rooms	22-24°C
	Offices	21-23°C
	Teaching Spaces	19-21°C
Summer internal design temperatures*: *(based on CIBSE Guide A comfort Criteria)*	Meeting Rooms	22-24°C
	Restaurant	24-25°C
	Gym	21°C
Summer internal design temperatures**:	In compliance with CIBSE TM52	

** Applies if mechanical comfort cooling is provided*

*** Applies if naturally ventilated. This may not be achievable in some or all existing buildings due to restrictions on opening windows and limited opportunities for external shading.*

Areas provided with comfort cooling: Gym (Building E)
Restaurant (Building I)
Meeting Rooms (Building I)

2.3 Domestic Water Services

Estimated daily water demand: *(based on IoP Design Guide)*	150-200 L per bedroom 7 L per cover (restaurant)
Estimated daily hot water demand: *(based on IoP Design Guide)*	115-135 L per bedroom 6 L per cover (restaurant)
Recommended hot water storage: *(based on IoP Design Guide)*	115 L per bedroom (dwellings) 45 L per bedroom (hotels) 6 L per cover (restaurant)
Shower flow rates:	Restricted to 10 L/min * **
Wash hand basin flow rates:	Restricted to 6 L/min *(BREEAM 'good' maximum 9 L/min)*
WC Cisterns:	5 L effective flush volume **
Baths:	180 L **
Urinals:	6 L/bowl/hour **
Kitchen taps:	Restricted to 10 L/min **
Dishwashers:	13 L/cycle (domestic size) ** 7 L/rack (commercial size) **
Waste disposal units:	Restricted to 17 L/min **
Washing machines:	60 L/use (domestic size) ** 12 L/kg (commercial size) **

** To comply with Building Regulations Part G2 (applies to new dwellings)*
*** To meet BREEAM 'Good' water consumption targets as dictated by Local Plan*

Boosted water delivery pressure:	3 bar at outlets ***

***** Only applies to outlets served by boosted water supply. Mains water supplies are likely to be used where appropriate*

Area water hardness	Moderately soft (72 mg/L $CaCO^3$) *(South East Water water hardness checker)*
Hot water circulation temperature:	55-60°C
Hot water delivery:	Limited to maximum of 48°C for baths

	TMVs recommended for basins and showers (max 43°C)
Scalding protection:	TMV3

2.4 Ventilation

Rooms with natural ventilation:	To comply with Building Regulations Part F for purge ventilation and background ventilation.	
Mechanical ventilation rates:	Bathroom extract	15 L/s
	Commercial kitchen extract	In compliance with DW172, hoods by specialist – assumed 40-60 air changes per hour
	Commercial kitchen supply	85% of extract rate
	Restaurant	10 L/s per person (if mechanically ventilated).
Mechanical supply conditions:	Commercial kitchen supply	10-16°C *
	Restaurant	18-20°C (if mechanically ventilated)

** Supply unit to consider the use of heat recovery*

Filtration:	Kitchen supply	Min G4
	General	Min F7
Room noise criterion	Bedrooms	NR20-30
	Bathrooms	NR40
	Commercial Kitchen	NR40-45
	Restaurant	NR35-40
	(Final noise levels to be confirmed by acoustic consultant)	

2.5 Electric Vehicle Usage

For the purposes of this report, it is assumed that five number 7.5kW (single phase) car charging points will be provided. Subject to practical and cost effective availability of suitable electrical capacity, it is intended that the charging points will be capable of simultaneous use at any time.

An alternative approach is to assume that the number of EV charging points will be determined by the available electrical supply rather than the electrical supply requirements being driven by a set number of charging points, with restrictions on charging use. For example, limiting charging times to periods when other use is limited (e.g., overnight charging only).

3. MAINS ELECTRICAL SUPPLY INFRASTRUCTURE

3.1 Existing Supplies

The existing site has numerous electrical supplies, not all of which have been identified during our survey.

There are currently two pole mounted transformers on site.

- Lydhurst 501448 Located in a wooded area to the Northeast of Mission House
  Available UKPN records show the HV supply to this transformer to be routed below ground, crossing the site from West to East in the fields to the North of the new Dutch Barn Building.
- Stonedelf 501447 Located to the West of the Dutch Barn
  From site survey the HV supply to this transformer is an overhead cable, running from the North, terminated at the Stonedelf transformer.

To date the capacity of the transformers has not been established.

The existing supplies that have been identified are:-

3.1.1 Building I - Reception/Restaurant

Available UKPN records show these supplies derived from the Lydhurst 501448 Transformer.

This building houses two three phase supply heads, both connected to a single supply cable which enters from below ground.

The supplies connected are

A. Three phase 100A (Max)
   Meter K10B01546
   Assumed MPAN (from bills) 19 000 423 9813
   The supply serves a 4 Way TP&N Hager MCB Distribution Board. From the Onsite labelling the following are supplied from the DB
   Streetlights – B32 (via RCD and Isolator)
   Games Room – B63
   Garage – B40
   Office – 63A (Office believed to be part ground floor and first floor of adjacent existing building)

   Two number single phase supplies are derived from this supply (Yellow Phase and Blue Phase in use)
B. Single Phase 100A (Max) – Believed to serve North Flat
   Meter Z0106410; Radio Tele Switch (80A) H0205120
   MPAN 19 000 1136 9661
C. Single phase 100A (Max) – Believed to serve Middle Flat
   Meter located in Flat, not inspected. NB No means of Isolation located in Garage.
   Assumed meter (from bills) K7901951
   Assumed MPAN (from bills) 19 000 1237 0019

3.1.2 Building D - Arts & Crafts

Available UKPN records show this supply derived from the Lydhurst 501448 Transformer.

D. Three phase 100A (Max)
   Meter K0110117

The Supply serves numerous items of loose switch gear via an Isolator (possibly 60A or 80A – labelling is difficult to read). Items served include 3 way single phase MCB DB; 100A DP Isolator; 100A/20mA TP RCD. Other than 2 circuits on the MCB DB (Garden Block Lights & Twin 13A Point Freezer) no items are labelled.

The supply is believed to also serve the following existing buildings

- Building E - Gym
- Building F – Yoga
- Building G Machinery Shed/Plant Space

3.1.3 Building H - Staff Facilities

Available UKPN records show this supply derived from the Lydhurst 501448 transformer.

E. Single Phase 100A (Max)
   Meter K7230022; Radio Tele Switch (80A) H0407980
   MPAN 19 000 7013 2305

3.1.4 Other Supplies

Other known supplies to other buildings on site, which sit outside of the current project works include: -

Available UKPN records show the following supplies derived from the Lydhurst 501448 transformer.

F. Mission House
   Meter D0213853
   MPAN 19 000 4037 0107

G. Aunt's House
   Meter K0110117
   MPAN 19 000 4533 1877

The supply is believed to also serve the following existing buildings

- Building A - Cookery School
- Building B - Wellness Centre
- Building C - Meeting Rooms/Offices

H. Garden Cottages
   Meter A13LB22076

MPAN 19 000 3436 8577

I. 1 Stonedelf Cottages
   It is assumed that th1 supply is derived from the Stonedelf 501447 transformer.
   Meter Z0071642
   MPAN 19 000 4933 1931

J. 2 Stonedelf Cottages
   It is assumed that th1 supply is derived from the Stonedelf 501447 transformer.
   Meter D13B240663
   MPAN 19 000 0333 2833

K. Main House
   Available UKPN records show the source of the supply to the House to be from the Warninglid Village LV Network, via a below ground cable running from the House to the East.
   Meter I06EB00359
   MPAN 19 000 1337 0534

L. Driveway Lighting (Supply Location unknown)
   Meter D9843187
   MPAN 19 000 0836 7770

M. Electric Gates (Supply Location unknown)
   Meter D15B001164
   MPAN 19 000 9124 7702

3.2 Proposed Supplies

It is envisaged that metered utility electrical supplies will be provided for groups of buildings.

There are many possible scenarios upon which the anticipated electrical load for each building can be estimated.

For the purposes of this report, we have assumed two scenarios. In both cases we have assumed the use of commercial grade efficient LED lighting, along with maximum and appropriate use of daylight and automatic controls (i.e., lights are not on when sufficient daylight is available or when a space is unoccupied).

Refer to appendix D, Estimated Electrical Loads for details of the assumed loads.

As the Dutch Barn is a new building, it has been assumed that heating will be provided with ground source heat pump heating and hot water generation by electric boiler in both scenarios.

3.2.1 Highest Demand Scenario

This assumes that the primary heating and catering fuel will be electricity and that Ground Source or Air Source Heat Pumps will be used to generate space heating, with electricity used for hot water generation.

It is anticipated that both the Lydhurst and Stonedelf transformers would be required to be upgraded, including upgrades to the local HV network in order to support the required additional load.

It may also be necessary to transfer some of the existing electrical load from the Lydhurst transformer to the Stonedelf transformer.

An initial approach has been made to UKPN, via Crown Energy to establish the feasibility and likely costs for providing the required supplies.

3.2.2 Lowest Demand Scenario

This assumes that the primary heating and hot water fuel will be LPG or Biomass and catering fuel will be LPG.

3.2.3 Proposed Design Scenario

This assumes that where practical, feasible and cost effective, Heat Pumps are used to provide heating and hot water, with LPG used as the primary catering fuel in all buildings other than Building J (Dutch Barn), and to provide heating and hot water to buildings which are not considered as being feasible to heat using Heat Pumps due to the difficulties in improving the insulation of the existing buildings to a sufficient level to make heat pump heating at this current time viable.

3.2.4 Load Comparison

The table below summarises the load requirements for the Highest Demand, Proposed and Lowest Demand scenarios. Refer to Appendix B for details.

Building	Highest Demand kVA	Proposed kVA	Lowest Demand kVA
A – Cookery School	114	31	13
B – Treatment Rooms	63	63	27
C – Meeting Rooms/Offices	47	20	20
D – Arts & Crafts	29	13	13
E – Gym & F – Yoga	51	51	9
G – Machinery Shed	2	2	2
H – Staff Facilities	26	26	5
I – Reception/Restaurant	222	79	79
J - Dutch Barn	61	61	61
Estate Lighting & Power	11	11	11
EV Charging	41	41	41
Total Estimate	667	406	281

(NB rounding of load estimates results in slightly differing figures in this table to those included in the full estimates included at appendix D)

3.2.1 Other supplies

It is currently anticipated that the existing supplies to the following buildings will be retained and adapted to meet the long term needs of the buildings in question.

A. Mission House
   Retained unchanged
B. Aunt's House
   Retained, with existing buildings forming part of the current scope of works disconnected from the supply
C. Garden Cottages
   Retained unchanged
D. Stonedelf Cottages
   Retained unchanged
E. Main House
   Retained and adapted to serve the existing Games Room and new swimming pools.

4. ELECTRICAL SERVICES

4.1 Arc Fault Detection

Arc Fault Detection Devices (AFFDs) are protective devices that are designed to reduce the risk of fire caused by faulty electrical installations.

> *"About one-third of all fires caused by electricity are attributed to hazardous arcing faults. Particular mention is to be made to serial arcing faults. Residual current protective devices (RCDs) and miniature circuit breakers (MCBs) are not designed to detect and safely disconnect serial arcing faults and do not offer adequate protection in such cases: for example damaged wire insulations, crushed or broken cables, bent connectors, loose contacts, or even defective electrical devices. The resulting electrical arcing faults can cause cable insulation to ignite, leading to a cable or even building fire."*
> https://www.siemens.com/global/en/home/products/energy/low-voltage/components/sentron-protection-devices/arc-fault-detection-devices.html

Arc Fault Detection Devices are recommended, within BS7671:2018 Requirements for Electrical Installations, as a means of providing additional protection against fire caused in electrical final circuits.

Regulation 421.1.7 (a new clause for 18th edition) states

> *"Arc fault detection devices conforming to BS EN 62606 are recommended as a means of providing additional protection against fire caused in AC final circuits.*
> *If used, an AFDD shall be placed at the origin of the circuit to be protected.*
> *NOTE: Examples of where such devices can be used include:*
> a) *Premises with sleeping accommodation*
> b) *Locations with a risk of fire due to the nature of processed or stored materials*
> c) *Locations with combustible construction materials*
> d) *Fire propagating structures*
> e) *Locations with endangering of irreplaceable goods"*

At present AFD Devices are only available for single phase electrical circuits rated up to 40A.

As with all advancements in technology there is a cost premium to AFDDs and, as the devices are physically larger than the more widely used Miniature Circuit Breaker (MCB) and Residual Current Breakers with Overcurrent protection (RCBO), there is also a requirement for more space for distribution equipment.

A hypothetical example, based on the use of Eaton equipment is set out below:-

> Assuming that the new 8 way three phase distribution board were to be provided for a given area, the following size and costs estimates would be appropriate, subject to the final scheme design.
>
> Please note that additional space will be required for cabling, trunking etc. and the dimensions given are for the Distribution Board enclosures only.

a) If AFD Devices are provided.
Approximate size of required enclosures:-

- 8 Way TP&N DB = 564 H x 440W
- 30 Module Din Rail Enclosure = 564 H x 440W
- 45 Module Din Rail Enclosure = 724 H x 440W

Approximate Costs (Based on Eaton published trade costs)

- Enclosures = £925.00
- AFDD Devices = £5,275.00
- Total = £6,200.00

b) If AFD Devices are NOT provided.
Approximate size of required enclosures:-

- 8 Way TP&N DB = 564 H x 440W

Approximate Costs (Based on Eaton published trade costs)

- Enclosures = £410.00
- RCBO Devices = £2,090.00
- Total = £2,500.00

Amendment 2 of BS 7671:2018 is expected to be published in the spring of 2022. It is anticipated that the amendment is likely to include mandatory use of AFDDs. Although publication is expected in Spring 2022, it is not currently known when the amendment will come into force.

4.2 Lightning Protection

With the exception of the Restaurant/Reception Building, the section of the existing stable block earmarked for office use, and the new Dutch Barn building, the existing buildings are all single storey.

Given the large number of mature trees on site, it is not anticipated that lightning protection will be provided to most buildings.

The Restaurant/Reception building is located in an area with relatively tall trees adjacent, although as the building is likely to house the campus wide data and communications network equipment it would benefit from a structural lightning protection system.

The Dutch Barn and Office Building are both also located in an area with relatively tall trees adjacent.

Whilst there is always a risk that a building might be struck by lightning, the decision as to whether or not a structural lightning protection system is provided is one that requires further discussion.

Whether or not a structural protection system is to be provided is, of course, subject to the Clients' personal risk perception, and perhaps that of their insurers.

Should the Client perceive the risk of loss of economic value or cultural heritage to be high, provision of a full lightning protection system should be considered and the layout developed in conjunction with the Architects to enable tapes where possible to be hidden from view.

BS EN 62305-2 suggests that a 'tolerable risk' of loss of human life due to lightning strike is 1 x 10-5 or 1 in 100,000.

MTA can provide a risk assessment quantifying the risk factor expressed in numerical value terms based on known parameters if required

It should be noted that provision of a Lightning Protection system does not reduce the risk of strike but reduces the risk that any strike will cause loss of life.

Surge protection will be provided to comply with BS7671, which is designed to mitigate the risk of fire and damage caused by external transient voltages which include lightning.

As the electrical installations will be designed and installed to BS 7671:2018, the installation of Surge Protection devices to all buildings is a mandatory requirement.

4.3 Fire Alarm

Subject to the findings of a site wide Fire Strategy to be completed by others, it is envisaged that each building will be provided with an independent Automatic Fire Detection (AFD) System, if necessary networked together to allow warning of a fire in any building to a central location and to allow warning of a fire in any building to be signalled to other buildings.

The Cause and Effect schedule, category and type of AFD system to be provided will be confirmed following the completion of the Fire Strategy.

4.4 Intruder Alarm

As the majority of buildings are likely to be occupied at all times, or occupied by visitors, a large scale intruder alarm system is not envisaged.

It may be prudent to install intruder systems in locations where high value goods or equipment may be stored (e.g. tractor, estate maintenance tools, wines and spirits).

4.5 CCTV

As with an intruder alarm system a large scale CCTV system is not envisaged. In addition, without a manned monitoring station, a CCTV system can only be used in a reactive capacity, in the event of an incident.

4.6 Standby Generator and UPS

As agreed with the Client that Standby generation or Uninterruptible Power Supplies (UPS) will not be provided as part of the project.

4.7 Photovoltaic (PV) Panels

Photovoltaic (PV) panels, or solar panels, are often used to generate electricity using solar power, which can reduce energy bills and net carbon emissions.

Since the removal of the feed-in tariff in 2019, the most cost-effective solar panel installation would be sized to ensure that as much of the electricity generated by the panels is used on site and not exported to the grid.

This can limit the size of the installation, as the electricity use during a typical summer week when the solar panels are producing their most may be low, although the catering kitchen does offer an opportunity for a relatively high use.

We would also recommend that any PV installation is provided with battery storage sized to ensure the PV generation over a typical week is stored, to be used when required during that week.

For Lydhurst, there is little opportunity to install roof mounted PV as the majority of buildings which form this phase of the project are shaded by mature trees, with the exception of Building G, the flat roof of which could be used to mount approximately $50m^2$ of PV Panel. In addition, a ground mounted installation could be provided.

The budget cost to install, for example a 100kW peak output system, is currently around £65,000. Battery Storage could cost a similar figure. The space required for a typical 100kW peak output system would be in the region of 50m x 20m.

No suitable and appropriate site has been identified for the installation of a ground mounted system.

There is a balance to be struck between maximising generation, minimising cost and gaining most benefit from the installation. An alternative approach is to provide as many solar panels as possible in order to maximise the amount of electricity generated. Much of the generated energy might be exported and provide little financial benefit but could be used to 'offset' carbon emissions during other times of the year when the solar panels are generating much less than is being consumed.

The Smart Export Guarantee is an obligation set by the Government for electricity suppliers to make payments for electricity exported to the grid using low-carbon generation, providing certain criteria are met. It came into force in January 2020. It is up to the electricity suppliers to set tariffs, so they vary widely between suppliers, but you could expect to be paid around 2-5p/kWh generated.

It should however be noted that whichever approach is taken for PV going forward, it is unlikely to ever pay for itself in energy savings within its typical expected lifespan. However, commercial installers of large systems are suggesting that a return of investment of 15% is not unusual.

5. TELECOMMUNICATIONS INFRASTRUCTURE

There are several existing overhead Openreach telecoms cables serving the estate, although it is not currently known where the cables enter the site.

The Client has confirmed that, if possible, all existing overhead cables on site should be removed as part of the project.

In order to remove the existing overhead (Openreach) telephone cables around the site a new below ground duct network will be provided, from the (as yet unknown) location at which Openreach telecoms services enter the site to the various locations around the estate where Openreach services are required.

A full schedule of required locations needs to be developed with the Client, although the following locations are assumed as requiring landline telephone services.

- Stonedelf Cottages
- New Restaurant/Reception building

It is assumed that telephone services to other buildings will form part of a private estate wide service.

In addition to the Openreach duct network, a private telecoms duct network will be provided to allow the installation of optical fibre cables from a central Estate Data Hub to each building.

The Client has confirmed that the incoming broadband facilities including a microwave link, and associated telecoms hardware will be provided by the Clients preferred Data provider. The Private data network will provide broadband and telephone services to each property.

6. DOMESTIC WATER INFRASTRUCTURE

6.1 Incoming Water Supply

The existing water supplies to the site have not yet been confirmed. On the site visit it was reported by the Client that most of the buildings have separate metered water supplies, and approximate locations of these water meters are known, however it is not currently known which meter serves which buildings or other services.

As the expected water usage of the buildings will greatly increase compared to the current use, and due to the unknown age and condition of the existing water supplies, it is proposed that all buildings in the scheme (A-J) are to be provided with new mains water supplies. It is assumed that the existing supplies to the Main House and Garden Cottage can be retained.

Plans for any plant rooms for the two new swimming pools have yet to be developed. We can therefore only assume the locations for new water supplies to serve the pools. Pool plant will be provided by others.

Once the approximate number of water fittings for all proposed buildings is known, we would recommend a capacity check is requested with the water network provider to ensure the local water network is able to supply the site with the required flow rate.

The water pressure from the existing water supply/supplies is not known at this time. A pressure and flow test can be arranged to confirm this. The water network provider will only guarantee water pressure above 1 bar (10 m head) at the property boundary. The site is likely to be provided with more than this, however this will vary depending on time and local demand.

It is the current design proposal that the incoming mains water supplies can be appropriately enlarged to meet the new design needs of the proposed building. If this is found not to be the case, water storage and pressure boosting will be used where required.

6.2 Cold Water Storage

If the required flow rate can be provided from a new mains supply, the proposal is to apply for a new site water supply, with individual metered connections to each building. If the required flow rate cannot be provided, on-site water storage will be needed. We would recommend that if water storage is necessary it is provided local within each required building.

If water storage is required, then generally outlets in baths, showers and basins would be served from water storage tanks. To keep water supplies to kitchens and drinking supplies as fresh as possible, we recommend these are to remain fed directly from the mains water supply.

6.3 Water Softening

The property is located in an area with “moderately soft” water. Therefore, we do not recommend that water softening is required.

6.4 Domestic Hot Water

Domestic hot water is best generated or stored close to the point of use to reduce the size of the distribution system and reduce heat losses from pipework. We therefore propose that each building has its own dedicated domestic hot water generation and storage, which can be linked to a centralised or local source of heat, depending on the heat generation approach selected.

The recommended method of hot water generation depends on the usage of each building. If a building only has one or two sinks which are infrequently used, an electric point-of-use water heater is proposed. Where there are multiple hot water outlets, outlets which are used frequently, or where large amounts of water are needed (e.g. baths and showers), we propose hot water cylinders are used, which would be fed by a boiler or heat pump system (normally the same as the space heating system). These cylinders will need dedicated plant spaces/cupboards, and depending on the building, multiple cylinders may be required where there is high anticipated hot water demand.

Based on our current understanding of the usage of the buildings, we currently estimate the following hot water generation and storage is required:

Building	Recommended Hot Water Generation	Hot Water Storage	Hot Water Generation Required
A - Cookery School	Electric point of use	10 L per sink (point of use heater only)	12 kW electric (4no. 3 kW heaters)
B - Wellness Centre	Hot water cylinder(s)	Hot water cylinder(s), size TBC	30 kW heat input assumed
C - Meeting Rooms	Electric point of use (building layouts required to confirm)	10 L per sink (point of use heater only)	3 kW electric heater assumed
D - Arts & Crafts	Electric point of use (building layouts required to confirm)	10 L per sink (point of use heater only)	3 kW electric heater assumed
E/F – Gym, Yoga Studio	Hot water cylinder(s)	Hot water cylinder(s), size TBC	30 kW heat input assumed
H - Staff Facilities	Hot water cylinder(s)	Hot water cylinder(s), size TBC	30 kW heat input assumed
I – Restaurant & Reception	Hot water cylinders	480 L for restaurant – assume 2no. hot water cylinders	60 kW heat input assumed
J – Dutch Barn	Hot water cylinders	690 L based on no. of bedrooms** – assume 3no. hot water cylinders	75 kW heat input assumed
Main House*	Hot water cylinders	495 L based on no. of bedrooms*** – assume 3no. hot water cylinders	75 kW heat input assumed

** Included for consideration in central plant sizing only*

*** Hot water storage sized based on assumption that Dutch Barn is treated as a dwelling*
**** Hot water storage sized based on assumption that Main House is treated as a hotel*

If hot water cylinders are used, these would contain a backup electric immersion heater in case of loss of the primary heat source, although this would not provide a recovery time as fast as the primary heat source.

A secondary hot water circulation loop will be used to reduce hot water draw off times and reduce the risk of legionella where required.

Automatic blending valves (referred to as Thermostatic Mixing Valves or TMVs) are required to all bath taps under the Building Regulations to reduce the risk of scalding. We would also recommend using TMVs on hot water supplies to wash hand basins and showers in public areas to reduce the risk of scalding, although sometimes they are provided with the fitting itself.

6.5 Reducing Water Consumption

Water consumption and possible sewage charges (depending on the approach) are a major consideration with sites that can use large quantities of water. The following are suggestions of possible systems that could be implemented to reduce the demand on treated mains water and provide a more long-term sustainable approach to water use.

6.5.1 Flow Restrictors

To reduce water usage, flow restrictors could be fitted to taps and can limit the flow rates to showers and baths. Reducing the size of baths can also reduce water usage and reduce the amount of water that needs to be stored. Flow restrictors will be required in the Dutch Barn to comply with Part G of the Building Regulations and in the new non-residential buildings to achieve a ‘good’ standard in regard to the BREEAM water consumption targets to comply with policy DP42 of the Mid Sussex District Plan.

6.5.2 Rainwater Harvesting

We would suggest that rainwater harvesting is considered to lower potable water use. This can be typically used to feed external irrigation supplies, but could also be used to flush WCs, whilst at the same time providing attenuation in the surface water drainage system and reducing the water discharged to soakaways. We suggest further investigation is made into systems as part of the civil works package.

6.5.3 Greywater Harvesting

These systems are similar to rainwater harvesting, except that they recover and store ‘grey water’ to be used for flushing WCs. Grey water tends to refer to waste water from showers and baths, which is directed towards holding tanks, where it is filtered and treated, before being pumped back into the building.

As much greater water treatment is needed than with rainwater, this is a more complex system and would need the involvement of a specialist. We therefore wouldn't immediately suggest this unless it is something the Client would like to pursue further.

6.6 Reducing Hot Water Generation Demand

The following technologies should be considered to reduce the need for hot water generation using the primary heat generator (e.g. boilers/heat pumps).

6.6.1 Domestic Water Heat Recovery

We would suggest the consideration of shower waste water heat recovery. Heat recovery devices are easy to install below shower trays, require little to no maintenance (if in a soft water area or if softened water is used) and pre-heat the cold water supply to the shower with the warm water running through the drain.

6.6.2 Solar Thermal Hot Water Heating

It is possible to reduce the heating demand for hot water generation by using solar panels to pre-heat the incoming water supply to the cylinders. Such systems need careful design to avoid legionella issues and we would suggest that they are kept as local to the hot water generation as possible.

The size of these systems are limited to avoid overheating, and they tend to work best in buildings with a high and fairly guaranteed hot water demand, such as hospitals and care homes. We would expect the hot water demand of the site to vary between peak holiday periods and more quieter times of the year. We therefore suggest that if solar energy is an option, it may be better to direct this towards solar PV electricity generation rather than production of heat, despite this being less efficient.

7. ABOVE GROUND FOUL DRAINAGE

As the layouts of the buildings are proposed to change from the existing layouts, new foul drainage will be required to serve the new appliances. The current plan is to feed these into a new below ground drainage system (designed by others) which would run alongside the existing system rather than adding load to the existing system.

Where the existing below ground drainage system is to be reused, we would recommend that a condition survey is carried out.

Once we have confirmed layouts of the buildings, we will be able to determine where new SVPs are required.

8. HEATING STRATEGY & INFRASTRUCTURE

From the site visit, it was recorded that the Main House, Aunt's House, Mission House, Building B, and Building I are provided with oil tanks and boilers. The Main House, Aunt's House and Mission House are outside of the scope of this report, except for the possible inclusion of the Main House in a site-wide heating solution. The age and condition of the oil boilers and tanks are not known at this time, but due to the extent of reservicing required, high carbon emissions, and the local planning policy to use renewables where feasible, we do not recommend any oil boiler systems are retained where new heating systems are installed.

Based on the number of buildings in close proximity, both a localised (within each building) or centralised approach to heat generation is possible.

Based on our prior experience of similar buildings, we have estimated the peak heating demands of the various buildings based on their floor area and assumed construction. Our current estimates are as follows:

Building	Construction	Assumed Peak Heat Loss per m^2 floor area	Approx. Floor Area	Peak Space Heating Demand
A - Cookery School	To Part L2A standards	70 W/m^2	125 m^2	9 kW
B - Wellness Centre	Existing (upgraded)	100 W/m^2	330 m^2	35 kW
C - Meeting Rooms	Existing (upgraded)	100 W/m^2	230 m^2	25 kW
D - Arts & Crafts	Existing (upgraded)	100 W/m^2	70 m^2	7 kW
E - Gym	To Part L2A standards	70 W/m^2	90 m^2	7 kW
F - Yoga Studio	Existing (upgraded) with new connection to Gym	100 W/m^2	195 m^2	20 kW
G - Machinery Shed	-		-	Unheated
H - Staff Facilities	Existing	100 W/m^2	65 m^2	7 kW
I - Restaurant	Existing w/ new extension	80 W/m^2	655 m^2	55 kW
J - Dutch Barn	To Part L1A standards	60 W/m^2	530 m^2	35 kW
Main House*	Existing	100 W/m^2	1078 m^2	108 kW
			TOTAL	**308 kW**

** Included for consideration in central plant sizing only*

The above estimates are only approximations and will be updated following finalisation/confirmation of the proposed/existing building fabric, including any proposed thermal improvements and the expected airtightness of the buildings. Heat loss calculations will be performed during RIBA Stages 3 and 4 as information on the building fabric and thermal improvement to be made becomes available.

We would estimate that the heat demand for domestic hot water generation from a central source (i.e. excluding electric point of use heaters), to be around 300 kW, subject to storage facility and recovery times. This assumes that hot water is being generated in all buildings at the same time.

The peak heat demand for space heating and hot water generation would therefore be around 600 kW, if the heating and hot water was being generated simultaneously in all buildings. This is unlikely to be required and would result in large central plant if this approach is taken, so we would assume an element of diversification when sizing centralised heat generation plant. In this case, a diversification factor of 75% would be appropriate, with the total peak heating demand becoming 450 kW for the site.

If other buildings on the site are to become part of the proposals and could be included in a centralised solution, these will need to be considered as part of the sizing of the equipment.

8.1 Building Regulations Part L Compliance

Part L of the Building Regulations sets out the energy performance requirements of a building that is to be newly built, to be extended, or to undergo a change of use.

The below is a summary of which parts of Part L of the Building Regulations are expected to apply to each building:

Building	Type of development	Floor area / extension area	Anticipated Part L compliance required
A - Cookery School	New building		L2A
B - Wellness Centre	Existing building - change of use		L2B
C - Meeting Rooms	Existing building - change of use		L2B
D - Arts & Crafts	Existing building - change of use		L2B
E - Gym	New building / extension	Gym and new part of yoga studio are effectively a 180 m^2 extension of the existing 105 m^2 Building F	L2A
F - Yoga Studio	Existing building - change of use		L2B
G - Machinery Shed	Existing building		L2B
H - Staff Facilities	Existing building		L2B

I - Restaurant	Existing building - change of use with new extensions		L2B
J - Dutch Barn	New building	N/A	L1A

Building Control will need to confirm which parts of the legislation apply to which parts of the site.

Refer to Part L2B Table 5 for recommended minimum standards for improving existing building thermal elements.

Table 5 **Upgrading retained thermal elements**

Element[1]	U-value W/(m².K)	
	(a) Threshold	(b) Improved
Wall – cavity insulation	0.70	0.55[2]
Wall – external or internal insulation	0.70	0.30[3]
Floors[4,5]	0.70	0.25
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation at rafter level[6]	0.35	0.18
Flat roof or roof with integral insulation[7]	0.35	0.18

Notes:

1 'Roof' includes the roof parts of dormer windows, and 'wall' includes the wall parts (cheeks) of dormer windows.

2 This applies only in the case of a cavity wall capable of accepting insulation. Where this is not the case it should be treated as for 'wall – external or internal insulation'.

3 A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.

4 The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.

5 A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.

6 A lesser provision may be appropriate where meeting such a standard would create limitations on head room. In such cases, the depth of the insulation plus any required air gap should be at least to the depth of the rafters, and the thermal performance of the chosen insulant should be such as to achieve the best practicable U-value.

7 A lesser provision may be appropriate if there are particular problems associated with the load-bearing capacity of the frame or the upstand height.

8.2 Assessment of Options

We have performed a desktop study of the available heating options, with a focus on possible low carbon and renewable technologies.

From the initial meetings/discussions with the Design Team and Client, we have established that:

- Policy DP39 in the Mid Sussex District Plan states that:

  "All development proposals must seek to improve the sustainability of development and should, where appropriate and feasible to the type and size of development and location [...] use renewable sources of energy"

  An assessment of options has been made in line with this agenda.
- It is currently not thought to be possible for articulated lorries to safely enter the site, as the north entrance is very narrow. Smaller lorries should be able to enter the site using this entrance.

- There is currently no space allocation within existing buildings for centralised plant such as biomass, as the buildings are all either occupied, are due to be converted as part of the proposals or are used for storage. Therefore, if large, centralised plant space is required proposals would either need to change or a new building would be required.
- The fabric of the existing buildings will be improved where this can be achieved without compromising the character of the building. Typically, glazing will be replaced with improved units, and roofs and floors will be insulated. Walls may be insulated in places, however this is subject to further investigation and design.

8.3 Site Primary Heat Source Technologies

Due to the size of the buildings and likely demands for heat, we have determined the following heating fuel sources are appropriate for further consideration:

- Biomass (wood chip or wood pellet)
- Electricity (converted to heat using heat pumps)
- Bulk LPG combined with boilers

We have excluded the following technologies as the primary heat source due to their poor efficiencies, high running costs, or incompatibility with the proposals:

- Solar technologies (unsuitable for winter heat generation)
- Direct electric heaters or storage heaters (high running costs, electrical supply would need to be increased, poor efficiency compared to heat pumps)
- Natural gas (no mains gas in area)
- Heating oil (highest carbon emissions)
- Combined heat and power (requires summer heat base load to increase running hours and improve efficiency)

8.4 Biomass Boilers

Biomass boilers burn timber fuel to generate heat for a heating system. The fuel is generally provided in two types: wood chips and wood pellets. Wood pellets are manufactured to a particular standard and are therefore generally a more expensive fuel. They are less likely to cause maintenance issues than wood chips, which can be more variable as a fuel source. As timber is a renewable source of fuel, biomass is seen as a low carbon technology, and close to carbon-neutral if it can be sourced locally.

Biomass boilers can be used as a direct replacement for oil, gas or LPG boilers. Compared to other boilers, they have a large footprint and typically are provided with large buffer vessels (insulated water tanks) to reduce the number of boiler starts and improve their efficiency. As a result, they typically require a much bigger plant space than for an oil or gas boiler. We would suggest that a plant room of approximately 60 m^2 would be required to provide heating and hot water for the whole site (although this will need confirming by specialist biomass contractors).

On top of this, a large amount of fuel storage is required. Wood fuel is typically delivered by lorry and either tipped or blown into a fuel store which needs to be located adjacent to the boiler room. The size of fuel store is dependent on the demand but we would suggest an area of around 30 m^2 m as a starting point. Fuel is then automatically drawn into the boilers from the store by a screw auger.

Fuel delivery access needs to be considered. It is understood that currently, articulated lorries cannot enter the site using the north entrance due to the gates and lack of turning space from the narrow road. The east entrance also cannot be used as the bridge is unsuitable for HGVs. Therefore, only small lorries would be able to be used for biomass deliveries similar in size to oil delivery lorries. This will increase the required number of fuel deliveries by around three times.

Lorries would need to be able to safely deliver the pellets or wood chips to the fuel store, so ideally this would be situated away from where guests would be walking. Fuel deliveries, especially when blown, can be very noisy, so this would either need to be situated away from sleeping accommodation, or be scheduled to avoid sensitive times of day when guests could be disturbed.

Biomass boilers require frequent maintenance, which can be quite hands-on, including ash removal and cleaning of components. The boiler flue gases can be high in NOx and particulates and sometimes supplementary flue components are sometimes necessary to ensure there is no impact on air quality.

For an element of resiliency, we would recommend two boilers are used rather than one to avoid complete shutdown of the heating system in case of boiler failure. It is also good practice for a biomass boiler installation to be provided with a form of backup heat generation, in case of issues with fuel quality or supply. We therefore suggest a backup LPG installation is installed to be used if necessary. The LPG boilers can be installed in the same building as the biomass installation and will need bulk storage tanks for fuel storage, although these could be much smaller than if this was used as the primary heat source (see LPG section).

A biomass system would be most efficient if it is sized to serve the whole site. This will centralise as much plant as possible in the new plant building. Biomass systems generally work better on larger scales, such as estate-wide district heating schemes where the boiler can remain running for long periods, with the use of buffer vessels. They are not ideally suited for single buildings with intermittent usage patterns.

The size of the biomass boiler flue(s) will depend on the number and size of boilers, and distances from trees and buildings. As a guide, the flue height can be assumed to be 6-8 metres high from ground level, and one flue will be required per boiler.

8.5 Heat Pumps (Electricity)

Heat pumps are a technology that uses a refrigeration cycle to extract heat from an external source, convert it from a low grade (low temperature) heat to a higher grade (high temperature) heat and deliver it to the heating system. Electricity is used as the driving force for the process. Heat pumps can extract heat from various sources, the most common options being the air and the ground.

8.5.1 Air Source Heat Pumps

An Air Source Heat Pump (ASHP) is a device that absorbs heat from outside air and feeds it into a heating system by using a refrigeration process to 'upgrade' the heat to a usable temperature. The colder the external air temperature is, the harder the heat pump has to work to extract heat from it. This means that when space heating demand is at its highest (during winter) the unit operates at its worst efficiency.

Although ASHPs require electricity to run, they are seen as a low carbon technology as they only use about a third of the electricity when compared to direct electric heating, with the rest of the heat extracted from the air. The efficiency of a heat pump is calculated based on the electrical energy it consumes compared to the amount of heat it produces. As a heat pump produces more heat than it consumes in electricity, they have efficiencies over 100% (typically averaging 270% for an ASHP).

The improved efficiency results in the running costs being comparable with gas boilers (this varies as the price of gas and electricity fluctuate over time), whilst being able to achieve net-zero carbon status through the use of a green electricity tariff.

Air source heat pumps (air-to-water) must be carefully designed when used for buildings with high space heating demands. Key considerations include:

- Location – a suitable external location in 'free air' is required for the heat exchangers to function correctly. Any enclosure must ensure that not only air flow is maintained but also has suitable access for maintenance. It is also important for the heat pump to be as close to the building it is serving as possible to reduce heat losses from external or buried pipes.
- Noise – the fans and compressors within the units can be quite noisy and may cause disturbance to the surrounding area. Acoustic surrounds are available but increase the size of the units. With no acoustic treatment, sound levels of 65dB(A) at 3m is not uncommon. This can be reduced by providing attenuation to the fans, although this increases the unit size and cost.
- Power supply – the required electrical infrastructure and capacity needs to be available.
- Water flow temperature – The maximum water temperature generated by a heat pump is typically 40-50°C which is below the 80°C provided by a boiler. For a building to be able to be heated efficiently by a heat pump it must be well-insulated. Historic buildings can struggle to get adequately heated by radiators with such a low water temperature. The solution to this is usually to provide oversized radiators to compensate for the reduction, which can have a negative visual effect within the space, or to move towards using heat emitters that work better at lower temperatures, such as underfloor heating.

Hotter water temperatures can be provided from the heat pump, usually up to 60°C, however come with a severe penalty to efficiency.

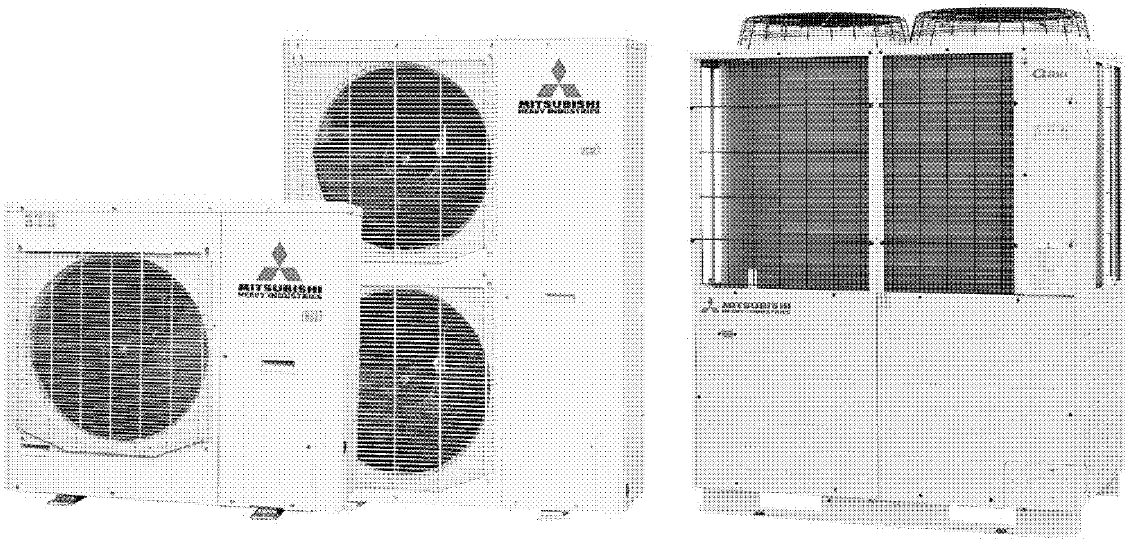
When used with an LTHW (water-based) heating system, an ASHP system will require an expansion vessel, circulation pump(s), and will typically require a buffer vessel to prevent the heat pump cycling on and off too often. Sometimes some of this can be provided within the heat pump casing.

Maintenance costs can be higher than with a boiler due to the increased number of moving parts and consumables and, they can be noisy particularly when they age.

Due to the high price of electricity, it is unlikely in the current market that air source heat pumps will offer much in the way of running cost improvements over LPG, however this may change if legislation is introduced to make cleaner forms of energy cheaper or penalise the use of fossil fuels.

In addition, the efficiency of the heat pump is directly related to the temperature of the water being produced (assuming an air-to-water/ground source system), with cooler water temperatures increasing the efficiency of the unit. They are therefore ideal for use with underfloor heating which operates at much lower water temperatures, but less so with radiators where higher water temperatures are needed to get the heat out from the radiators. Heat pumps can also serve indoor air conditioning units (air-to-air system) by circulating refrigerant around the building rather than circulating water, however our preference is to use air-to-water systems in order to keep refrigerant runs to a minimum.

Domestic hot water will require the heat pumps to run at their maximum operating temperature, reducing the available efficiency and cost effectiveness, so it is common practice to provide multiple heat pumps, allowing some to remain running at lower temperatures serving the space heating, whilst the others convert to higher temperature to generate domestic hot water on a hot water priority basis. Air source heat pumps that used CO_2 as the refrigerant can run more efficiently at high temperatures and could be used for dedicated hot water generation.



Left: Multi-split ASHP external units for space heating and cooling
Right: CO_2 ASHP for domestic hot water generation

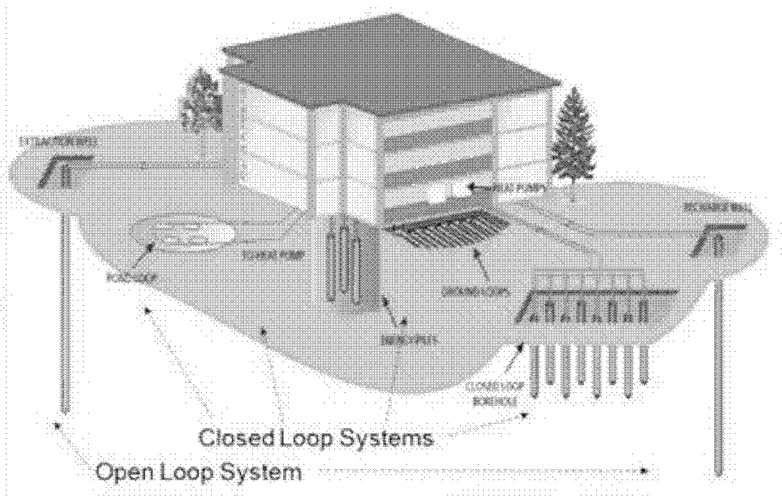
If air source heat pumps were to be used for the Main House, in addition to requiring a large outdoor area to house the units, the size of units would offer acoustic concerns, so would need to be located away from any bedrooms.

The Dutch Barn could be served by air source heat pumps, but as there is a large field immediately adjacent to its plot, and a shed that could be used for any indoor equipment, we recommend a ground source heat pump is more appropriate on the grounds of the improved efficiency achieved (see below).

8.5.2 Ground Source Heat Pumps

Ground Source Heat Pumps (GSHPs) work similarly to air source heat pumps (air-to-water) but extract heat from the ground rather than the air. This system has the advantage of sourcing heat from the more consistent ground temperature, which rarely drops below 10°C, therefore improving the efficiency of the heat pump.

GSHPs consist of an indoor unit and a ground loop. The ground loop is a long length of pipework that is buried underground. This may be orientated horizontally in an array or vertically in one or more boreholes.



Types of ground loop systems

There are two main types of ground pipe loops, either shallow in which 1 m deep trenches are dug in a field creating a network in which the pipe can be laid, or boreholes in which a piling machine typically drills 100-150 m deep holes in which the pipe can be placed.

Typically, shallow ground loops are cheaper and come with less complications, however require significant areas of land.

As a rough estimate, to produce the 300 kW of heat required for space heating for the site, around 14,000 m^2 would be required to install horizontal 'slinky' pipes, and 4,500 m^2 would be required if boreholes were to be installed.

This is far above the amount of free space on site that would be available without disturbing trees. The new car park would have an approximate area of 2,000 m^2, for example.

We therefore do not recommend that a ground source heat pump system is feasible as a site-wide solution. However, a small number of individual buildings may be able to be served from ground source systems where land is available close by, and where the buildings are sufficiently well-insulated. The Dutch Barn building would appear to be well-suited for use with a GSHP system. The internal plant could be located within the existing store next door to the building to avoid taking up space in the new building, as long as this is suitably weathertight and insulated.

Once the ground works and pipe infrastructure are installed, these should have a typical design life of 50-100 years. The heat pump itself, with a typical 10-15 year lifespan, can be replaced without re-doing everything over again.

The higher efficiency of these heat pumps, when compared to air source heat pumps, should result in less demands on the size of electrical supply.

8.5.3 Recommended Use of Heat Pumps at Lydhurst

Our recommendation is that heat pumps are not suitable to be implemented in a site-wide centralised approach. If heat pumps are to be used, we would suggest they are provided separately to individual buildings.

Heat pumps are most suited to well-insulated buildings, especially where underfloor heating is the only form of space heating, as the heat pumps can run more efficiently at lower temperatures.

We therefore suggest heat pumps are used to remove applicable buildings off of a site-wide fossil fuel approach, should this be deemed the most appropriate way forward.

We would recommend air source heat pumps are utilised in the following locations:

- Cookery School (space heating)
- Treatment Rooms (space heating and hot water)
- Gym and Yoga Studio (space heating, cooling, hot water)
- Staff facilities (space heating and hot water)
- Restaurant building (cooling to restaurant, heating and cooling to meeting rooms)
- Swimming pool heating (assumed summer use only)

We would recommend a ground source heat pump for the following building:

- Dutch Barn (space heating and hot water)

Air source heat pumps are especially suitable for heating swimming pools during the summer, as the higher air temperature allows the heat pump to run more efficiently than in the winter.

Typical air source heat pumps are not ideal for generating domestic hot water, as they run less efficiently to generate the higher temperatures required, leading to high running costs. However, separate air source heat pumps could be used for hot water generation that use CO_2 refrigerant. These will allow the heat pumps for space heating to be smaller in size and run at lower temperatures.

8.6 LPG Boilers and Bulk LPG Storage

LPG is an alternative to heating oil as a delivered fossil fuel source for use with boilers. It comes with a number of advantages over oil which are listed below:

- LPG is a cleaner fuel, contains less contaminates and has a lower carbon factor (i.e. produces lower carbon emissions).
- LPG allows the use of more efficient gas fired boilers, which have better turn-down ratios, work better at part-load and take more advantage from condensing technologies.
- LPG boilers are relatively small, reducing the required plant room size compared to oil or biomass.
- LPG boilers can take advantage of direct weather compensation, reducing water temperature in line with external temperatures and reducing the risk of overheating and improving boiler efficiency.
- BioLPG is entering the market as a ‘greener’ alternative to standard LPG, although availability at the current time is limited.

We would suggest the use of LPG as a stepping stone to move buildings off oil heating if net-zero carbon options are not possible at this time. Any LPG systems should be designed in such a way that low carbon technologies could be added in the future without full replacement of the system.

8.6.1 Fuel Storage

Multiple bulk LPG storage tanks will be required. The size and number would need to be confirmed during the next design stage, however, if all space heating and hot water generation for the site (Buildings A-J & Main House) is to be provided from LPG, then 4no. 4000 L buried tanks would likely be required.

The rules with regards to the placement of tanks are as follows:

- LPG tanks can either be above ground or below ground, however they must be placed outside (not within buildings).
- Assuming 4000 L buried tanks are used, the tank covers must be 7.5 m away from buildings, boundaries, and source of ignition, and there must be a 3 m clear zone around the tank. Trees canopies must not be within 3 m of the tank cover.
- The tanks must be located in the direct line of sight of the delivery lorry filling point.
- Buried tanks must not be located where vehicles could drive over them and should not be located where tree roots could damage them.

As a result of the above, it is not uncommon for the storage tanks to be provided within a fenced compound outlining the clearance space required around the tanks. If buried, the only visible element of the tank is the turret which contains the access hatch to the tank.

If this is to be further pursued, we would suggest approaching an LPG supplier who will perform a site visit and provide further advice regarding tank size, locations and costs.

Access for delivery lorries must be considered, particularly if located near to public areas.

8.6.2 Location of Tanks and Boilers

As LPG is stored at medium pressure, the tanks can be positioned far away from the boilers without it affecting the installation in any way, so the boilers could be located within any or all of the buildings without affecting the tank location.

Ideally, boilers are better located within the building they serve, as this reduces distribution losses and makes the system more efficient.

The following factors should be considered with regards to the location of boiler rooms:

- As LPG is heavier than air (unlike Natural Gas which is lighter) it will sink and stagnate. As a result LPG installations cannot be installed or run through basement areas.
- The boiler room must be provided with the required ventilation for combustion and heat removal.
- The boiler room must provide a route for the boiler flue to discharge above roof level.
- The equipment will produce noise which will escape through the ventilation openings. Silencers and other noise reducing equipment are generally not allowed as they limit the air for combustion.

8.6.3 Cooking/other LPG usage

If LPG is to be used for cooking or for any fireplaces/firepits, the same bulk storage supply can be used.

8.7 Recommended Approach for Planning

Following discussion with the Client after receiving a budget quote for the electrical upgrade required for all buildings to be heated using heat pumps (Highest Demand Option), it was noted that this was not a feasible approach. There were also major concerns with a biomass solution, mainly due to the lack of access for articulated lorries which would need to regularly deliver fuel.

It was therefore decided that LPG would be used as the primary form of heating on the estate, with heat pumps used in the buildings well insulated enough for them to run efficiently. The primary reason behind this is to reduce the cost of the electrical upgrade to a level which means the project remains financially feasible. In all cases where LPG boilers are used, the new infrastructure and services would be sized so that these buildings could switch to heat pumps in the future without having to reinstall the heating distribution/emitters.

It is assumed that multiple LPG tanks will be buried close to Lydhurst House where small LPG lorries will be able to park adjacent, accessing the site from the north. From here, buried LPG pipes would run to a boiler room in Building I. This boiler room would serve Building I and Lydhurst House (via buried heating pipework). This is to avoid a new plant room in the main house, and reduce the amount of overall plant locations and flues.

At the moment, Buildings C and D are not being developed, but the intention is that these would be served by an LPG boiler room located in one of the buildings, supplied by the buried tanks. If it is found to be feasible to serve these buildings with heat pumps instead, then this would be the preferred strategy.

The Dutch Barn is proposed to be served by its own ground source heat pump system. The ground array would be installed in the neighbouring field, and the heat pump equipment would be located in the existing store building which is to remain next to the Dutch Barn.

It is the intention to serve the remaining buildings (A, B, E, F & H) with air source heat pumps. The heat pumps would be located immediately adjacent to each building. Depending on whether cooling and hot water generation is also required, and the heating demands of the buildings, multiple units may be required. These may need screening or acoustic treatment.

8.8 Reducing Energy Consumption

8.8.1 Improving Thermal Performance

It is often recommended that allocating finance towards improving the thermal efficiency of a building is prioritised over installing energy-efficient and/or low carbon heat generation, as this can drastically reduce energy usage and will continue to be of benefit for the rest of the building’s lifespan. As it can reduce peak heating demands, it provides the extra benefit of making more efficient, lower temperature heating systems, such as heat pumps and underfloor heating that may have previously been unviable, an option going forward.

Building fabric standards have been based around Building Regulations recommendations. It is understood that the general approach for the existing buildings will be to insulate all existing roofs, insulate floors where underfloor heating is to be used, and insulate walls in places (to be confirmed by the Architect).

8.8.2 Intelligent Controls

It is important that energy is not wasted through the use of poor controls. We would suggest the following are incorporated into the design of the new heating systems:

a) Weather Compensation

This is a control methodology that lowers the generated water temperatures as external air temperature rises. The benefit of this is that the lower water temperatures can be generated more efficiently by condensing boilers and heat pumps, reducing energy consumption. As external air temperatures rise, heat loss should reduce so the hotter water temperatures shouldn't be needed. This also helps reduce thermal shock, as heat emitter outputs modulate to some degree with heat demand, providing a more even warm up.

Weather compensation controls are more difficult to incorporate into systems that are also generating domestic hot water, as they must switch back to their highest temperature whenever there is a hot water demand. However, in some cases, this would be generated separately to allow the heating system to run at its most efficient all the time.

This is vital for use with heat pumps, as the generated water temperature has a huge impact on generation efficiency. Quite often this is provided as standard on new commercial boilers and heat pumps, but does not apply to biomass boilers which generally need to run at higher temperatures.

b) Optimum Start

This is a self-learning control methodology that uses the previous days to calculate how quickly the heating system warms the building and uses this to bring the heating on at the appropriate time to achieve the internal temperature at the desired point. There are different types of system, some very complex and requiring bespoke software, and some more basic that are built into off-the-shelf thermostats.

It means that when setting your heating programme you would set it for the time you want the building warm, instead of when you want the heating to come on. The controller would then work out when to bring the heating on to achieve this. As a result, energy wasted by bringing the heating on too soon and keeping the building hotter than it needs to be, is reduced.

c) Remote Operation

If a centralised BMS solution is implemented, this would be able to be remotely operated and enable remote monitoring of the energy usage of the buildings and metered utility supplies. (See BMS section for further details).

8.9 Impact on Carbon Emissions and Achieving Net-Zero Carbon Status

Although reduction of energy consumption is important and should be appropriately considered in order to ensure that the buildings are operating as efficiently as possible, ultimately the sources of fuel are the most important factor when considering how to achieve net-zero carbon status.

We believe there are two ways this could be achieved:

1. Supply all generation from on-site renewable technologies, such as biomass boilers and solar photovoltaic panels.
2. Supply all generation from utilities provided through net-zero carbon tariffs, such as renewable electricity and bio-LPG. A proportion of this could be generated via on-site renewable technologies to lower fuel utility use.

8.9.1 Bio-LPG

Some LPG suppliers are offering 'Bio-LPG', which is made as a by-product of biodiesel. However, there is currently little supply available, which is generally being reserved for large organisations with greater use, so there is no guarantee that a supply would be obtainable.

8.9.2 Decarbonisation of Electricity

Zero-carbon electricity tariffs are also commercially available, with around 50% of tariffs now claiming some sort of renewable credentials.

In addition, grid electricity is getting cleaner each year. The latest CCC report (June 2021) suggests that carbon emissions from electricity reduced by 15% in 2019-20, which followed a 14% reduction in 2018-19.

The carbon intensity of the grid is now estimated as 0.182kgCO2e/kWh which is lower than previous estimates, and this is recommended to drop to less than 50gCO2e/kWh in 2030 and 10gCO2e/kWh by 2035.

The below table summarises the same technologies above and their current possible carbon emissions status.

Fuel	Carbon Factor of Fuel ($kgCO_2e/kWh$)	System Efficiency (%)	Carbon Factor of Useful Heat ($kgCO_2e/kWh$)	Possible Net-Zero Carbon Status
Oil	0.285	90%	0.316	Highest CO_2 emissions and no 'green' alternative available, so would require carbon offsetting.
LPG	0.230	90%	0.256	'Bio-LPG' tariff may be available (limited supply), otherwise would require carbon offsetting similar to oil but lower amount.
Direct Electric Heating	0.233	100%	0.182	Net-zero carbon 'green' tariffs commercially available. Likely to continue to reduce year-on-year.
Air Source Heat Pumps	0.233	270%	0.067	Net-zero carbon 'green' tariffs commercially available. Likely to continue to reduce year-on-year.
Ground Source Heat Pumps	0.233	350%	0.052	Net-zero carbon 'green' tariffs commercially available. Likely to continue to reduce year-on-year.
Biomass (Woodchip)	0.015	85%	0.018	Depends on the sustainability, sourcing and locality of the fuel, but

				typically seen as net-zero carbon if responsible
Biomass (Pellets)	0.015	90%	0.017	Depends on the sourcing and locality of the fuel, but typically seen as net-zero carbon if responsible

Carbon factors for fuels have been sourced from the GOV.UK Greenhouse Gas Reporting: Conversion Factors 2020 website.

9. BUILDING CONTROLS (BMS)

The two main options for the control of the mechanical and electrical systems at Lydhurst would be a centralised, site-wide BMS (building management system), or a local standalone system for each building.

Building management systems can be used to control lighting heating, ventilation, fire detection and alarm systems, security and access control systems, and monitor energy usage, equipment performance and alert management to equipment faults.

A centralised approach is more suitable where buildings are served by centralised plant or systems. As most buildings will have their own heat generation plant, this may not offer much benefit, as local systems would still be able to link back to a central server or app. It may be suitable to have a centralised BMS system covering Buildings A-I, however if these buildings are to be managed separately, then local systems would be more appropriate.

The functionality of the controls system within each building would typically include:

- Time control for heating and domestic hot water generation
- Temperature control for space heating (typically zoned to each room)
- Weather compensation for heating systems
- Frost protection / night set-back
- On/off/auto control for primary heating and ventilation systems
- Sub-metering for gas (LPG), water and electricity
- Critical alarms for all systems
- Fire alarm interface for mechanical equipment (to shut down equipment)

Remote operation of the controls systems could be provided, which would allow building managers to log in to the system remotely to control or monitor the systems.

The controls systems philosophy will be developed with the Client as the design of the buildings and M&E services move forward.

10. MECHANICAL SERVICES STRATEGIES

The proposed usages of the buildings are varied in terms of activity and schedule. Some buildings are domestic in nature (e.g. Dutch Barn) while the majority are more commercial (e.g. Restaurant). The buildings include well-insulated new builds and existing buildings which are to be thermally improved and/or extended. Therefore, mechanical services approaches will vary for each building to cater to their specific needs.

This section of the report offers a broad overview of the intended mechanical services strategy for each building, based on our assumptions at this time. These are illustrated on our RIBA Stage 2 Concept Design sketches, which have been issued to the design team.

10.1 Building A – Cookery School

If possible, the building is proposed to be heated using underfloor heating only. This will require the floor to be suitably insulated throughout. Additional heating may be required in the Teaching Space, however this will be subject to design development. Underfloor heating manifolds could be located in the Back Kitchen and possibly in a small cupboard in the WC.

Teaching Space (Kitchen)

This part of the building is highly glazed, which will mean the heat losses of this part of the building will be relatively high, even if double or triple glazing is used. As this building is only likely to be used during the day, the design conditions may be able to be relaxed with regards to external temperature compared to other buildings which would need to be heated through winter nights.

Extract ventilation will be required in this room due to the cooking facilities. Instead of treating this room like a commercial kitchen, which would require a large amount of mechanical ventilation, we would suggest this room is treated as a cookery classroom in a school, and therefore we would apply the guidelines from BB101, which require a lower ventilation rate. We believe this is suitable, as the cooking stations will be used intermittently for classes, and there is additional natural ventilation from the high level windows.

High level exposed ducts would be used for extract ventilation. Ideally, recirculating hoods would be provided over each hob to remove grease from the air and reduce the amount that makes it into the ducts. The extract fan would be located on the flat part of the roof, hidden from view from ground level. When the extract ventilation is running, the make up air would enter the building through air bricks into a trench heater along the south side of the room.

Hot water is proposed to be generated using electrical point-of-use heaters. If water usage is low, the sinks may be able to be served by a single electric heater with water storage located under the worktop. This is subject to further design once the expected usage of the sinks is understood.

Meeting Room

We would suggest that cooling is not required in this room as it is unlikely to get much solar gain and would not be used for extended periods of time.

We would suggest a mechanical ventilation with heat recovery (MVHR) system is used to provide fresh air to this space. This system would extract air from the Back Kitchen, Stores and WC. The MVHR unit would be a horizontal unit mounted on the flat roof above the Meeting Room.

Back Kitchen / Cleaners Store

We do not currently have any details of this room. We are assuming this is a food preparation area, in which case mechanical extract from the MHVR system will be provided.

Dry Store & Cold Store

These rooms will be provided with mechanical extract ventilation from the MHVR system. The Cold Store refrigeration equipment will be specified by a specialist and will likely need external equipment.

10.2 Building B - Wellness Centre

It is proposed that this building will be provided with underfloor heating if the building fabric is upgraded sufficiently. Manifolds would need to be located in cupboards (probably 3 to cover the building). The floor will need to be insulated throughout. It may be possible to use the existing floor trench for pipe routes. The basement and/or the Store will be required for mechanical plant including hot water storage.

As many of the rooms will be used for massages, it would not be suitable to ventilate these rooms with the windows, as there could be cold draughts. Therefore, we propose the Treatment Rooms are ventilated with an MVHR system, with a heater battery in the supply duct to ensure a consistent supply air temperature is maintained to all rooms. The required ventilation rate will be low enough for the air movement to be virtually unnoticeable in the rooms. The ducts can be hidden within the new ceilings and walls so only air valves/grilles will be visible.

Solarium

The Solarium/Greenhouse will become very hot when there is direct sunlight and is likely to be difficult to heat sufficiently in colder weather. We therefore propose that this is a relatively untreated space to avoid wasting energy. It should be noted that the Reception may become quite hot due to the glazed screen to the greenhouse, which will let through sunlight and heat from the room. This could be investigated further during design development.

10.3 Building C – Meeting Rooms

The plans for this building are yet to be developed, as it is unlikely to form part of the first phase of works.

10.4 Building D – Arts & Crafts

The plans for this building are yet to be developed, as it is unlikely to form part of the first phase of works.

10.5 Building E/F – Gym & Yoga Studio

It is proposed to heat this building using underfloor heating alone. This will require the floor to be insulated throughout and the remainder of the building fabric to be upgraded to reduce heat losses sufficiently. The floor finish would also need to be compatible with underfloor heating.

Gym

Ideally, this building will be naturally ventilated for as much of the year as possible. This would be through the high and low level windows in the gym. During the winter, to avoid having to open the windows, fresh air is proposed to be brought in via fan coil units concealed within the wall thickness so the incoming air can be heated and avoid draughts. These fan coil units could also provide cooling from a reversible air source heat pump in a multi-split arrangement.

The Architect has questioned whether a thermal labyrinth could be utilised in the gym. A thermal labyrinth is effectively a long air intake with a high thermal mass with a fan on the end that aims to pre-heat the air in winter and pre-cool it in summer as a result of the incoming air being in contact with the ground.

If a thermal labyrinth is to be implemented, it would need to be carefully designed and constructed to ensure:

- The labyrinth is airtight and air does not 'short-circuit' through gaps in the construction
- The labyrinth remains dry and does not let in rainwater or groundwater
- The labyrinth does not let in rodents, insects or birds
- The labyrinth would remain clean and not allow dust, leaves etc to build up inside it. It is unlikely a concrete labyrinth would be able to be cleaned effectively.

An alternative solution which would be easier to install, maintain, and would be less likely to run into issues would be an 'earth pipe' system, which would provide the same benefit as a thermal labyrinth but usually uses buried plastic pipework and is an off-the-shelf specifically designed product for this purpose. The earth pipes could be located both under or outside of the building and are designed to maximise heat transfer with the ground. We would recommend if pre-treatment of the air is taken forward that earth pipes are used over a thermal labyrinth.

With either of these solutions, the incoming air would only change temperature by a few degrees before it is brought into the gym (depending on the length of the air path). We would therefore recommend that the incoming air is provided with a heater battery to top up the temperature before it is supplied to the space, along with filter and fan.

Yoga Studio

We are proposing windcatchers are installed on the roof of the yoga studio to naturally ventilate this space. We are proposing this space is provided with underfloor heating only at the moment, however this will be confirmed following detailed heat loss calculations. This is assuming the building will be sufficiently insulated to allow this and that the conditions in the room would not need to exceed around 21-23°C. If this room is to be used for hot yoga, then additional heating/air conditioning would be required which would need additional external heat pump units as well as internal units.

Shower Block
We are proposing that these rooms are underfloor heated and have extract fans in the ceiling voids. Room for hot water storage would be required. This could be in the Yoga Studio store room, but would ideally be within the shower block close to the heat pump.

10.6 Building G – Machinery Shed

We are not proposing any mechanical services are installed in this building.

10.7 Building H – Staff Facilities

As this building will be used intermittently, we would propose an air-to-air heat pump system in the main space is used as this would be able to quickly heat and cool the space as required.

Hot water will be generated using a dedicated air source heat pump with hot water cylinder.

The WCs will need extract ventilation so an MVHR unit is recommended to extract from the WCs and supply fresh air to the main space.

10.8 Building I – Walled Garden Restaurant, Reception, Club & Meeting Rooms

Generally, this building is to be thermally upgraded with the floor and roof being insulated. This should allow underfloor heating to be used throughout, however this is to be confirmed following detailed heat loss calculations.

Restaurant

With regards to ventilation, the main dining space could be either naturally or mechanically ventilated. Due to the low room heights and limited space for ductwork and air handling plant we do not believe a suitably sized mechanical ventilation system is possible, therefore directing the design to a naturally ventilated route.

While there are a large amount of openings on the west side of the restaurant, these would not be able to be opened in the winter, as this would result in high heat losses and cold draughts. We are therefore proposing that windcatchers are used to provide ventilation to the space. This would be more controllable than using windows and the external air will be able to better mix with the air in the room before coming into contact with anyone, resulting in more comfortable conditions for diners.

We have consulted with a windcatcher manufacturer, Monodraught, who have advised that two windcatchers would be sufficient to ventilate the room, assuming a maximum capacity of 70 people. Each windcatcher would need to be ducted from the roof down to high level on the ground floor. Ideally, the duct would run vertically down to terminate in the ceiling, but it is also possible to terminate through a high-level grille in the wall.

Kitchen

The commercial kitchen will need mechanical extract ventilation. We have assumed 40 air changes per hour will be required. Treated supply ventilation will be required for the make up air. The extract hoods are normally sized and selected by the kitchen specialist with MTA specifying the ductwork and fans.

Under the current design, there is no ceiling in the kitchen, so the ductwork would be at high level in the space, with the fans located either at high level in the kitchen or above the store rooms on the east side. (Note – we would advise that a ceiling to conceal high level services is recommended to avoid grease build-up on high level surfaces that will be difficult to clean and therefore create a H&S issue. The kitchen design specialist should advise further.)

Large louvres will be required for the kitchen intake and exhaust air. These could be located on the east elevation at high level, replacing the windows shown. Each louvre will need to have a face area of around 2.5 m^2. It is not ideal to have both the intake and exhaust air on the same elevation, and we have looked at the possibility of using a jet exhaust hood which could be located on the roof. These tend to work better than louvres as they require less cleaning and maintenance, and jet the smells away from the local area. We would recommend this is further considered as the design develops.

Lindab jet exhaust hood

We will need to know what dishwashing equipment is proposed in the pot wash as this may also need a high ventilation rate in the room, to be provided by an additional independent ventilation system.

Reception

We propose that this area is naturally ventilated, using high level openings if possible.

WCs

The WC block will require mechanical extract ventilation. As the floor-to-ceiling height is quite low on the ground floor, ducts will need to remain small. Ducts could connect to air valves in an IPS behind the WC pans.

Club Room

Due to the lack of space for mechanical ventilation plant and the lack of existing openings for natural ventilation, it is proposed that this room is provided with natural ventilation from a windcatcher. Monodraught have advised that a single unit would be sufficient assuming a maximum occupancy of 40 people in the main room.

Meeting Rooms

As the meeting rooms may be densely occupied for extended periods, we have assumed that cooling may be required at times. We therefore propose these rooms are supplied with heating and cooling from an air-to-air heat pump system, with either ceiling- or wall-mounted internal split units. These would be able to be controlled individually or all together, depending on whether the partitions between the rooms are open or closed.

At the moment we are proposing these rooms are ventilated using openable windows in each room, however we may be able to incorporate these into the windcatcher system.

10.9 Building J – Dutch Barn

The Dutch Barn will be heated using underfloor heating throughout. The heating demands of this building should be quite low.

We would suggest the building is naturally ventilated in summer (purge ventilation), whilst using an MVHR system for background ventilation in winter (in lieu of trickle vents). This would likely use multiple, small MHVR units located in cupboards. The system would extract air from WCs and bathrooms and supply air to bedrooms, living rooms and corridors.

There is a shortage of space in the current design for an MVHR unit to serve the two-storey suite. We recommend that this is provided as the design of the building develops.

The MVHR design will be developed during RIBA Stage 3 and the number of units and space requirements confirmed.

11. REDUNDANCY AND RESILIENCY

We would suggest following a tiered approached to redundancy where different levels of infrastructure are provided based on the perceived risk. The following outlines the general approach we suggest:

Risk – Disruption of fuel supply
Likelihood – Low risk if heating oil or LPG. High risk if biomass fuel due to the variability of the standard of fuel from suppliers.
Response – High risk biomass solution provided with back up LPG system. Lower risk LPG solution provide bulk storage with low level alarms to activate before the tank is completely empty.

Risk – Loss of heat generating equipment due to downtime for maintenance or component fault
Likelihood – Medium risk
Response – provide multi-equipment cascade systems – for example provide multiple boilers/heat pumps so that loss of a single piece of equipment does not result in whole system loss. This may not be practical if each building has independent heat sources as the plant spaces required in each building will become quite large. Therefore, a risk may be accepted that individual buildings may go without heat if their heat source breaks down.

Risk – Disruption of mains water supply
Likelihood – Low risk (assuming new supply installed)
Response – Bottled water to be stored to cover short-term loss of potable water supply. Guest accommodation / WC blocks could be provided with water storage tanks within the building to cover 50%-100% of daily usage.

Risk – Loss of circulation pumps
Likelihood – Low risk
Response – provide twin head pumps with automatic changeover so that on loss of the lead pump the circulation is switched to the backup pump. Repair can then be arranged outside of normal usage hours.

Risk – Catastrophic failure of heating system resulting in complete loss of heating and hot water.
Likelihood – Very low risk
Response – Provide back-up electric immersion heaters within hot water cylinders to provide domestic hot water and facilities to provide temporary plug-in electric heaters around the building to provide temporary emergency heating.

Risk – Loss of cooling unit/chillers
Likelihood – Low risk
Response – No action. Back-up cooling systems are not normally required as their loss does not result in possible damage to the building fabric and furnishings – unlike loss of heating which may result in frost damage and damp.

APPENDIX A – SCHEDULE OF RIBA STAGE 2 SKETCHES

This report should be read in conjunction with the following RIBA Stage 2 Concept Design drawings:

Document Title	No.	Rev.
M&E Services Concept Building A Layout	SK01	P2
M&E Services Concept Building B Layout	SK02	P2
M&E Services Concept Building B Sections	SK03	P1
M&E Services Concept Buildings E&F Layout	SK04	P2
M&E Services Concept Buildings E&F Sections	SK05	P2
M&E Services Concept Buildings E&F Elevations	SK06	P2
M&E Services Concept Building H Layout	SK07	P1
M&E Services Concept Building I Ground Floor Layout	SK08A	P3
M&E Services Concept Building I First Floor Layout	SK08B	P3
M&E Services Concept Building I Roof Layout	SK08C	P3
M&E Services Concept Building I Sections	SK09	P3
M&E Services Concept Building I Elevations	SK10	P3
M&E Services Concept Building J Lower Ground	SK11	P1
M&E Services Concept Building J Upper Ground	SK12	P1
M&E Services Concept Building J First	SK13	P1
Lydhust Estate Electrical Services Strategy	SKE100	P2
Lydhust Estate Mechanical Services Strategy	SKM100	P3

APPENDIX B – ELECTRICAL LOAD ASSESSMENT

(Please see separate attachment)