Design Report for a Biomass Installation

at

Thorngrove Garden Centre

Common Mead Lane
Gillingham
Dorset
SP8 4RE

PRIVATE AND CONFIDENTIAL

Introduction

The remit of this study was to provide a biomass design and district heating scheme, taking into account all relevant factors for the long-term heating of the existing and future buildings on the site. These factors include efficiency, fuel handling, localism, meeting user requirements, financial viability and minimising site impact or disruption.

The report includes the following:

Biomass system design

- Plantroom location
- Boiler Capacity, thermal storage & plantroom components
- Flue specification
- Fuel type/storage/feed system
- Distribution system and specification
- Building connections
- Heat meter location and specification
- Control and monitoring equipment

Executive Summary

Dorset County Council (DCC) have engaged with Bioheat on behalf of Thorngrove Garden Centre, to provide this design report. The purpose of this report is to design the most suitable biomass district heating scheme, replacing the current oil and electric heating, with a new sustainable and carbon neutral, renewable heating system.

The aim of this document is for DCC to invite a list of possible suppliers to provide Thorngrove with a Tender proposal for the design, provision and installation of a biomass boiler system. This will allow Thorngrove to understand which supplier will be capable of meeting the requirements, and to identify a preferred supplier based on the information returned.

This report details the viability of each building for connection to the district heating network, whilst evaluating the existing infrastructure and heating systems. We have also included future heat use in the design and capacity of the proposed system.

Where possible, heat loading for each building has been calculated in line with our experience and industry standards. These guidelines calculate the fabric heat loss of the walls, floor and roof area independently and are based on the temperature difference between the designed indoor temperature and the outdoor temperature and the 'U-Value' of the given fabric.

It is advised that the requirement for planning permission should be requested by Thorngrove Garden Centre. All other necessary permissions and approvals should be the responsibility of the contractor.

Table of Contents

Overview of Thorngrove Garden Centre

Thorngrove Garden Centre has been running for over 50 years, and is located close to the centre of Gillingham. The Garden Centre was taken over in 2017 by Employ My Ability, and is a friendly and enjoyable place to visit, where the majority of plants are grown on site.

It is an ideal site for the installation of a biomass heating system due to a number of key criteria based on the environmental, conservational and financial elements of the site.

The operation of the heating system is critical to the workings of the Garden Centre. This is not only with regard to heating the buildings for members of the visiting public and staff, but also for heating the glasshouses. The glasshouses, as an example, need to be heated to a constant temperature to ensure the correct conditions for the plants, and most importantly frost protection. The glasshouses are currently heated with two aging oil boilers which are increasingly costly to run and inefficient. The under-bench heating pipes however, are to remain, and serve their purpose well.

The installation of a district biomass heating scheme is also anticipated to be financially attractive, providing additional site income from the Government's Renewable Heat Incentive (RHI) scheme, and removing future cost risks associated with reliance on volatile oil prices and increasing electricity prices.

One of main aspects of our design has been to ensure that the site can encourage localism, by sourcing fuel from the local area where possible. To enable this to happen, the fuel store has been designed accordingly, for either blown chip delivery from one of the main fuel suppliers, or for tipped deliveries from either a lorry, or tractor and trailer.

The appointed contractor should use boilers which are capable of fuel versatility, for the same reason.

Plantroom Location

The site plan on the following page shows the main buildings to be included in the district heating network, and the location of the plant room and fuel store in relation to them.

The location of the boilers and fuel store can be seen on page 6, outlined in black. This is deemed the most suitable due to good available space in an existing building, convenient access for fuel deliveries, secluded from the main garden centre so as not to disrupt day to day operations, and is visually unobtrusive with regard to the flues.


POTTING SHED
FUEL STORE
PLANT ROOM
WORKSHOP
NEW SHOP
SHOP
CAFE
OFFICES
TEA ROOM
Nursery
SITE FOR NEW CAFE
SITE FOR NEW GLASSHOUSE
OSHO LEELA HOUSE
GLASSHOUSES
Thorngrove

System Design

Two new woodchip boilers, each with a rated capacity of close to, but more than 200kW, will be installed in the existing building as indicated on page 6. The boiler will be supplied with fuel from a chip store constructed within the same building, with a useable chip capacity of 75m³. Woodchip can be blown directly into the hopper, or tipped into a trough and transported to the fuel store by chip lifter. A district heating network will distribute the heat to the buildings on site.

The table below shows the maximum heat demand and flow rates for each of the buildings. This summarises the total capacity, and not all of the buildings have yet been constructed. An assessment has been made on the future buildings to allow for addition to the system at a later date. Therefore, two boilers of at least 200kW output each, with a large buffer tank, will be sufficient to heat the entire site, with flexibility to manage the gradual increase in demand as plans progress.

The nature of the site and the uncertainty as to when and if all of the buildings will be added, are pertinent to why it has been deemed appropriate to design the system with two boilers. The benefit being a further degree of flexibility in the system. The boilers can be run separately or together, depending on the level of demand. In the future when all proposed buildings are connected, the boilers can be used to manage the differences in summer and winter load.

Table 1. Flow rates for each connection:

Building	kW	l/s
New workshop	20	0,25
Potting shed	10	0,16
Cafe	5	0,08
New cafe	20	0,25
New Glasshouse	60	0,74
Glasshouses	186	2,29
Osho Leela	97	1,59
New Shop	20	0,33
Shop	10	0,16
Office/Tea-Room	30	0,49

The estimated annual heat energy demand to be supplied by the new biomass system is 330MWh initially for the existing buildings, increasing as the remaining are added to the system.

Every potential contractor will have their own preferred manufacturers, suppliers and installation methods. This document details the design requirements as far as is practicable, as a specification for the performance and function of the completed installation. It is recognised that different boiler manufacturers will have variable capabilities and as such, where this may be the case, there are optional inclusions, particularly with reference to

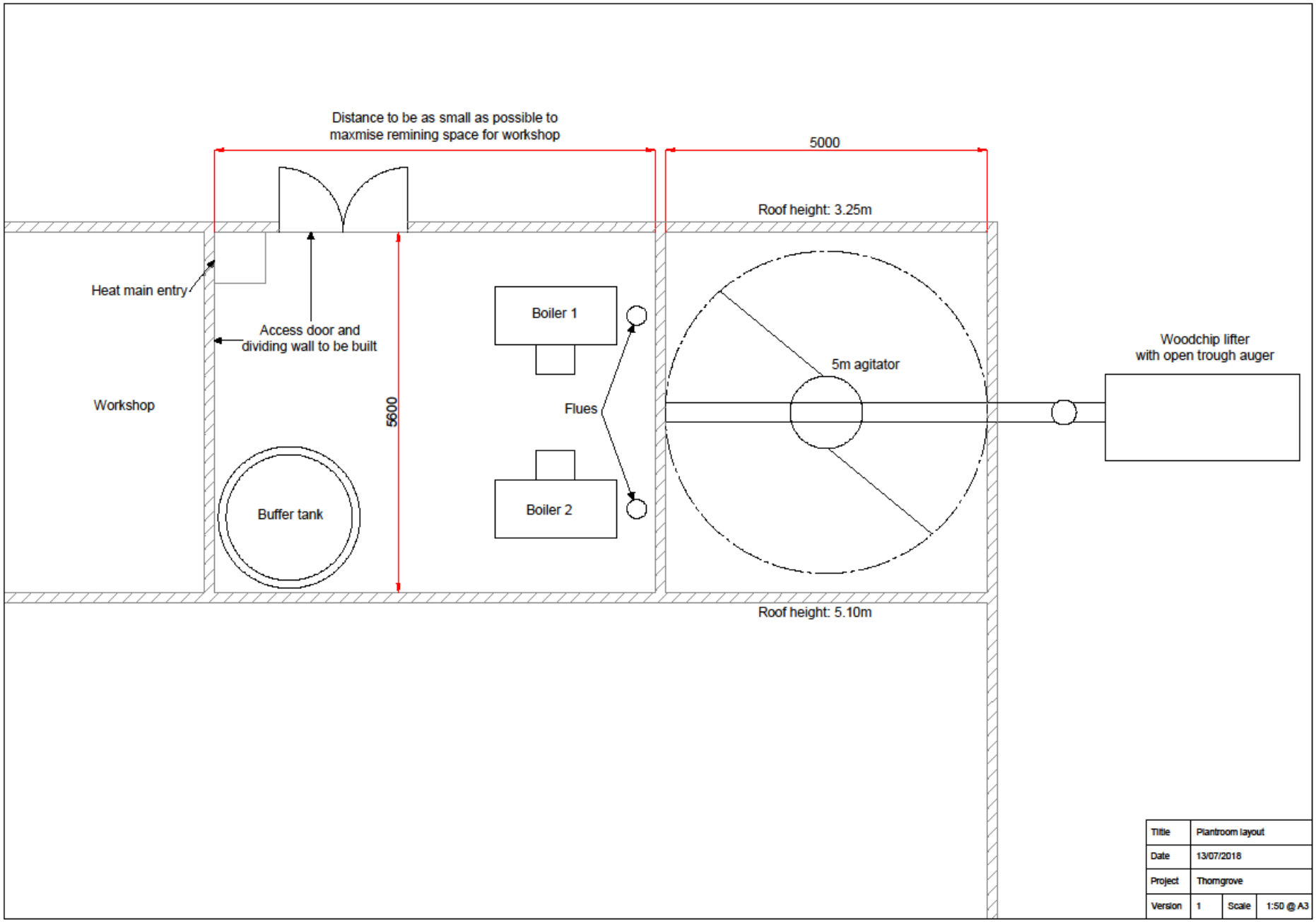
control functions. However, the remaining requirements laid out in this document are the minimum specification required and any modification to this should be clearly noted with the reason for the amendment to the main design parameters.

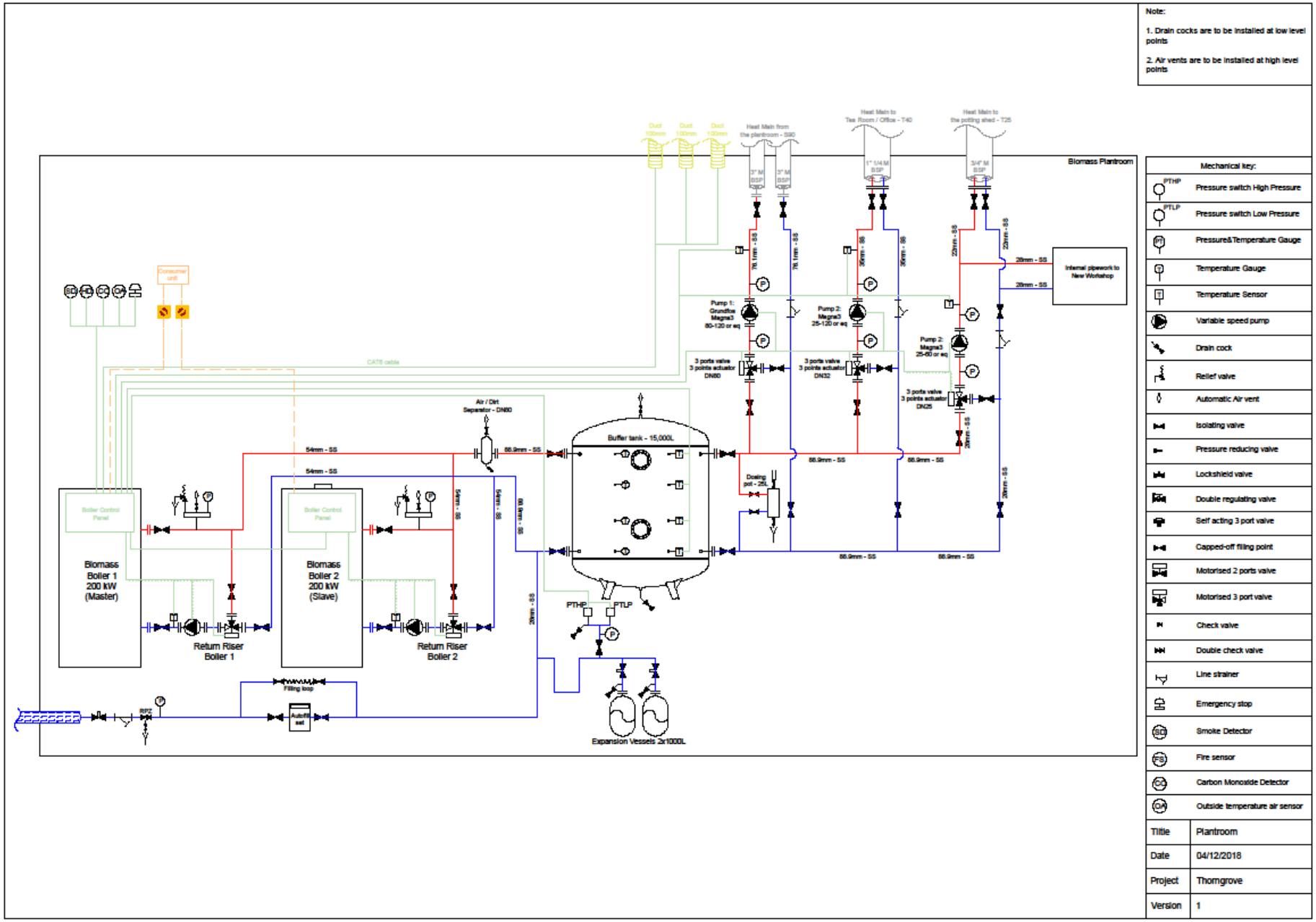
The information provided is for costing purposes, and the chosen contractor should complete a full technical survey to confirm all points, in particular the distances for DHP routes as this may vary depending on exact location of trenches.

Boiler Capacity & Thermal Storage

The total heat demand for the site has been calculated to be 458kW. Therefore, the proposal is to install two boilers, each with a capacity of 200kW (exact manufacturer output dependent, minimum of 200kW capacity each), with a 15,0000L buffer tank, to manage peak load but also to have the flexibility to manage gradual increase in demand as the various buildings are added to the system, and for summer/winter load.

Plantroom and fuel store layout shown on page 9, and schematics on page 10. Full schematics can be found in the accompanying Appendices.


Distance to be as small as possible to
maxmise remining space for workshop
5000
Roof height: 3.25m
Heat main entry
Access door and
dividing wall to be built
Workshop
5600
Buffer tank
Boiler 1
Flues
Boiler 2
5m agitator
Woodchip lifter
with open trough auger
Roof height: 5.10m
Title
Plantroom layout
Date
13/07/2018
Project
Thorngrove
Version
1
Scale
1:50 @ A3


Note:
1. Drain cocks are to be installed at low level points
2. Air vents are to be installed at high level points
Biomass Plantroom
Heat Main from the plantroom - S90
Heat Main to Tea Room / Office - T40
Heat Main to the potting shed - T25
Internal pipework to New Workshop
Consumer unit
CAT6 cable
Pump 1: Grundfos Magna3 80-120 or eq
Pump 2: Magna3 25-120 or eq
Pump 2: Magna3 25-60 or eq
3 ports valve 3 points actuator DN80
3 ports valve 3 points actuator DN32
3 ports valve 3 points actuator DN25
Air / Dirt Separator - DN80
Buffer tank - 15,000L
Dosing pot - 25L
PTHP
PTLP
Biomass Boiler 1 200 kW (Master)
Biomass Boiler 2 200 kW (Slave)
Boiler Control Panel
Return Riser Boiler 1
Return Riser Boiler 2
Filling loop
Autofill set
RPZ
Expansion Vessels 2x1000L
Mechanical key:
Pressure switch High Pressure
Pressure switch Low Pressure
Pressure&Temperature Gauge
Temperature Gauge
Temperature Sensor
Variable speed pump
Drain cock
Relief valve
Automatic Air vent
Isolating valve
Pressure reducing valve
Lockshield valve
Double regulating valve
Self acting 3 port valve
Capped-off filling point
Motorised 2 ports valve
Motorised 3 port valve
Check valve
Double check valve
Line strainer
Emergency stop
Smoke Detector
Fire sensor
Carbon Monoxide Detector
Outside temperature air sensor
Title Plantroom
Date 04/12/2018
Project Thorngrove
Version 1

Flue Specification

Each boiler is to have a separate flue. Flues from the boilers will pass out through the roof. All flue work, including roof works, is within the scope of the Contractor's works. Asbestos register to be supplied by the site owner.

Fan assistance of the flues is not to be used. The flue design, construction and commissioning must comply with prevailing European and UK regulations, particularly EN 13384 Part 1, chapter 10 of CIBSE AM15 Biomass Heating 2014. The flue heights should be the minimum necessary to achieve the compliances outlined above and a safe, efficient, fully functioning installation.

The Contractor will be responsible for achieving compliance of the flue system with all relevant prevailing regulations and obtaining the necessary approval and certification from relevant bodies. Particular attention should be given to approval by the Local Authority under The Clean Air Act 1993 or equivalent legislation.

Provision must be made for:

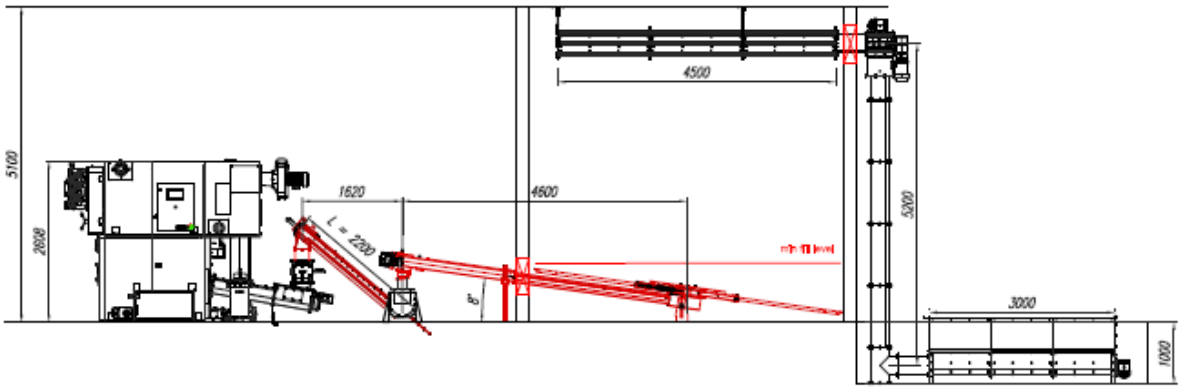
- Draft stabiliser
- Flue gas analyser point(s)
- Access points to enable inspection of the flue(s) without the use of a remote camera
- Access points to facilitate cleaning
- Condensation/rain water drainage
- Explosion relief

Fuel Type/Storage/Feed System

The proposed fuel type is woodchip, ideally locally sourced. The fuel store is sized at 5m x 5m for an appropriately sized agitator. Three of the fuel store walls are existing, and a dividing wall between the fuel store and plant room will need to be constructed (to comply with the appropriate fire regulations). The existing walls will need to be strengthened to withstand the weight of the woodchip in the fuel store. As two boilers are required, the contractor can use either a double auger, or a single auger splitting in the plant room to feed both boilers. This will be dependent on the boiler manufacturer's specification.

The design incorporates a chip trough and lifter, for greater fuel delivery options. Therefore, the fuel store will be able to take either blown or tipped woodchip deliveries. There is easy access from the carpark to the lane adjacent to the fuel store. The delivery vehicle will be able to drive into the lane which is restricted to members of the public, and can safely blow or tip the fuel without disrupting the public access to the garden centre.

The trough for the chip lifter is to be below the surface of the lane so that vehicles can still drive over it when not in use. Example shown below (actual dimensions may vary. Dimensions for the fuel store can be found on page 9):



Due to the versatile design of the fuel store, it is recommended that the fuel feed equipment is robust, and able to accommodate fuel of variable size and moisture content.

Distribution system and specification

The heat main will be split into three legs, as shown on the schematics (page 10). Approximate routes and distance to the existing buildings shown below. Exact locations of new buildings still to be confirmed. However, an additional tee should be allowed for on the largest of the legs, to allow for the addition of the new glasshouses and café.

A pre-insulated pipe will be used to connect the new boiler house to each building. The heat distribution network must be capable of delivering the flow rates specified.

The principal features of the system will be:

- A design flow and return temperature of 80/60℃ or 80/65℃ at the heat exchangers depending on the building connection.
- The maximum allowable head loss in the distribution circuit is to be no more than 300 Pa/m
- At least one 100mm duct is to be laid in the heat main trench by the Contractor. On completion of the works 6mm polypropylene rope(s) (pull throughs) are to be left in the duct(s).
- If the Contractor's chosen method of bringing an electrical supply into the boiler room is via the heat main trench the cable should be installed in a second separate duct.
- The pre-insulated carrier pipe (heat main) should be of flexible type such as cross linked polyethylene (PEXa).
- The pre-insulated (heat main) insulation should be of blown polyurethane foam such as Rauthermex, or equivalent.
- The pre-insulated pipe must have a design life in excess of 25 years based on continuous operation at a temperature of 80℃ and pressure of 3 bar(g).
- The pre-insulated pipe should have a 10 year warranty if possible.
- Pre-insulated pipe must be installed as per the manufacturer's instructions using the manufacturer's proprietary fittings and tools.
- All pre-insulated pipe building connections should be as the manufacturer's recommended method and use the manufacturer's proprietary fittings.
- Where possible pre-insulated pipe should be laid in continuous lengths. Any unavoidable underground joints should be to manufacturer's recommendations, and be appropriately sealed and insulated.
- Joints using threaded fittings can be used provided:
    - They are housed in access chambers or pits.
    - Fittings must be of genuine type from the pipe manufacturer.
    - Fittings must be installed strictly to manufacturer's instructions, particularly with regard to allowance for expansion and contraction
- Pre-insulated pipe should be buried to a depth and in a manner according to the manufacturer's instruction for mechanical protection. Protection should be provided for 30 tonne vehicles.
  Proposed heat main routes shown below.

Underground heat main		
Name	Length	Size
A	20m	T25
B	63m	S90
C	3m	S25
D	24m	S90
E	5m	S40
F	3m	T25
G	36m	S75
H	3m	S63
I	10m	S63
J	30m	T40
K	2m	T25
L	15m	T40
M	30m	T32

Underground heat main

Building connections		
	Name	Head load
1	Biomass plantroom	-
2	New Workshop	20kW
3	New Shop	20kW
4	Shop	10kW
5	Offices/Tea Room	30kW
6	House	100kW
7	Glasshouses	190kW
8	New Glasshouses	60kW
9	New Cafe	20kW
10	Cafe	5kW
11	Potting Shed	10kW

Building Connections

The schematics shown in the appendices show the optimum methods for control of each building connection, including M-Bus heat meter visualisation. However, it is acknowledged that not all of the main boiler manufacturers can cater for the distances on this network. Therefore, as close to the optimum system is preferred.

Pipework terminations at each connection should generally use pre-fabricated lead in bends to terminate above ground level internally to each building for pricing purposes. It is acknowledged that on groundworks survey, the chosen contractor may have to amend the connections to external lead in bends.

As described in the table below, some of the buildings have no existing heating circuits, which need to be installed, or existing radiators which need to be replaced. Subject to full survey by the chosen contractor, until it is confirmed with the client where the new radiators can be sited in each room, and appropriate pipe runs, our suggestion is that an average cost per radiator is provided which is to include pipework, fittings and controls.

Buildings	**Method of Connection**
New Workshop	This is the remaining area of the barn where the plant room and fuel store are to be located. To be converted into a workshop at a later date when fully enclosed. Direct connection as all secondary side will be new. Pipework to be taken through the newly constructed wall of the plant room which will be adjoining, and capped off ready for heating circuit to be installed at a later date. A QP 1.5 heat meter should be installed in readiness. The blower shown on the schematic is an example emitter (TBC). No DHW requirement.
Potting Shed	Currently heated with electric heaters. The contractor is to remove the existing heaters and install pipework and radiators, and all items as per the schematics for direct connection and a QP0.6 heat meter. The peak demand is <10kW. Secondary side pipework should not be plastic. No DHW requirement.
Existing Café	The café is currently very small with no existing heating. The contractor is to install radiators and heating circuit for a maximum of <5kW, for direct connection, plus a QP0.6 heat meter, and all components on the schematics.
New Café	Future connection.
New Glasshouses	Future connection.
Existing Glasshouses	Currently heated with two oil boilers (one not working), through common header, split into two separately pumped systems for each existing glasshouse. The DHP will connect to a 190kW heat exchanger connected to the existing system with the oil boilers left in place. The oil boilers will need to be separated in line with regulations for RHI compliance. The heat meter and other components as per the schematics.

House (Osho Leela)	Currently heated with one oil boiler which must remain as back-up. This must be separated in line with the regulations for RHI compliance. The DHP will connect to a 100kW heat exchanger, heat meter, and all other components as per the schematics.
New Shop	To be added to the system at a later date when existing barn is converted. The DHP should be capped off where it enters the building, ready for future direct connection to the new heating circuit. A QP1.5 meter to be fitted in readiness for future use. No DHW requirement.
Existing Shop	The shop currently has electric heating. This is to be removed, and new radiators to be installed for direct connection from the DHP. All items as per the schematics. No DHW requirement.
Offices/Tea Room	There is an existing external oil boiler which is to remain. The DHP should connect to a 30kw heat exchanger which must be housed in an appropriate location inside the building, with the heat meter and other components on the schematics. The existing boiler must be separated in line with regulations for RHI compliance. Some of the existing radiators are insufficient for the rooms they are heating and need to be replaced.

Heat Meter Location & Specification

- One heat meter, such as Itron, at each building connection, as per the schematics.
- All heat meters to be RHI compliant and installed to manufacturer's instructions.
- All heat meters will be of fluid oscillator, swing jet or ultra-sonic type and be certified to MID Class 2 or better and provided with compliance/calibration certificates.
- All heat meters must be able to cope with flow rates given in Table 1 (page 7).
- Heat meter visualisation via M-bus connection preferred.

Control & Monitoring Equipment

- Controls should be compliant with Approved Document Part J and designed to minimise system losses and maximise system efficiency as far as possible.
- All controls will be fully interlocked to ensure that distribution pumps run only when there is a demand for heat from the relevant heating zone.
- All PHE should have an automatic balancing valve flow regulator of a type capable of allowing flow rate measurement.
- The pressure drop across the secondary side of each heat exchangers at design capacity is to be no greater than 10KPa.
- Oil boilers, where present, to be retained as a back up.

As a minimum, the biomass boilers and heat distribution system will respond to calls for heat from each building's heating circuits, with a constant 80/75°C flow temperature throughout the year. Demand will come from the buffer, which in turn is managed by the boilers.

Dependent on the contractors chosen boiler manufacturer, a more advanced level of control would be preferable to improve efficiencies. The most favourable would be the capability for the boilers to take control of everything, with weather compensation in each building, adjusting the heating supply temperature to the outside temperature. As a result, the system will use less fuel, and comfort levels in the buildings will be improved.

The best system would be full control by the biomass boilers, capable of automatically modulating temperature and flow rate in response to target temperatures from the buildings. It is acknowledged that not all of the major biomass manufacturers can achieve this due to the distances of the network. If this is the case, weather compensation in some buildings where possible will be more favourable than none.

Civils

The Contractor must undertake all civils. Approximate costs to be supplied subject to site survey for confirmation of scope of works.

Inclusions:

Plant room civils – construction of dividing wall between plant room and workshop, addition of access door in external wall, creating apertures in the roof for flues, provision of scaffolding to be included.

Three phase electrical supply and water main supply to plant room.

Fuel store civils – construction of fuel store wall between plant room and fuel store, strengthening/reinforcement of additional walls.

Chip lifter civils – excavation for underground trough, and reinforcement for vehicle access once installed.

Building connection civils – entrance to each building connection below ground with internal lead in bend where possible, externally where internal lead in bend not possible.

Groundworks – All trenchwork for DHP, backfilling and making good. The site is open to members of the public so the Contractor must use appropriate health and safety procedures. Work areas must be cordoned off for safety, areas which may pose any risk to the public to be supervised by trained personnel and warning signs used.

Installation Requirements

The Contractor must include provision for the following:

- Risk assessments and method statements. Health and Safety: The contractor will be responsible for the health and safety and security of the construction site until the point of completion and handover.
- Project management.
- Water testing and inhibitor install.
- Commissioning and Tests on Completion, including:
- To follow and complete the manufacturer-supplied commissioning checklist for the boilers and all associated components (buffers, fuel feed system).
- To supply and follow a sequence for pressure testing and adding inhibitor to the system.
- To verify the correct operation of all primary hydraulic equipment (pumps, valves) by operating secondary system controls to initiate heat calls.
- Secondary systems will then be verified by checking e.g. radiator temperatures, hot water availability.
- The electrical installation will be tested during and on completion of works. All tests will be carried out in accordance with BS 7671:2008 and Guidance Note 3 (Inspection and Testing). Electrical testing inherently involves some degree of hazard, these hazards will be identified and continually monitored throughout the duration of the installation, paying particular attention to The Electricity at Work Regulations 1989. All electrical test equipment used will conform to BS EN 61010 and BS EN 61557 and where appropriate the requirements of GS38 will be observed for test meter leads.
- A copy of the Electrical Installation Certificate along with a schedule of inspections and schedule of test results will be issued.
- CO monitors will be supplied.
- Training on the control system and customer maintenance obligations.
- Supply of manuals for all main components.
- Delivery.
- Plant hire.
- RHI Application and provision of an Independent Metering Report (IRMA).