Haringey Satellite Schemes

North London Strategic Alliance

July 2012

PARSONS BRINCKERHOFF

Haringey Satellite Schemes

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LIST OF ABBREVIATIONS

AAP	Area Action Plan
AMR	Annual Monitoring Report
CCGT	Combined cycle gas turbine
CCL	Climate Change Levy
CEM	Contract Energy Management
CHP	Combined Heat and Power
CIBSE	Chartered Institute of Building Services Engineers
CIL	Community Infrastructure Levy
CRBO	Community Right to Build Order
DCLG	Department for Communities and Local Government
DEN	Decentralised Energy Network
DG	Distributed generation
DH	District Heating
DNO	Distribution network operator
DPCR	Distribution Price Control Review
DPD	Development Plan Documents
DUoS	Distribution use of system
EfW	Energy from Waste
EPN	Eastern Power Networks
ESCo	Energy Services Company
ETC	Environmental Technologies Complex
FTE	Full Time Equivalent
GCV	Gross calorific value
GFA	Gross Floor Area
GLA	Greater London Authority
HTHW	High temperature hot water
HV	High voltage
IWMF	Integrated Waste Management Facility
ktpa	Kilo tonnes per annum
LBWF	London Borough of Waltham Forest
LDA	London Development Agency

LDDs	Local Development Documents
LDO	Local Development Order
LPN	London Power Networks
MSW	Municipal Solid Waste
MUSCo	Multi-utility Services Company
MW(e)(th)	Mega-watt (electrical) (thermal)
NDO	Neighbourhood Development Order
NDP	Neighbourhood Development Plan
NLSA	North London Strategic Alliance
NLWA	North London Waste Authority
NLWP	North London Waste Plan
NPV	Net present value
OAPF	Opportunity Area Planning Framework
PB	Parsons Brinckerhoff
PPA	Power Purchase Agreement
PPA	Planning Performance Agreement
PPS	Planning Policy Statement
RDF	Refuse Derived Fuel
RHI	Renewable Heat Incentive
ROC	Renewable Obligation Certificate
RRP	Resource Recovery Plant
SIGE	Spark ignition gas engine
SPD	Supplementary Planning Document
SPG	Supplementary Planning Guidance
SPV	Special purpose vehicle
SRF	Solid Recovered Fuel
TfL	Transport for London
UKPN	United Kingdom Power Networks
ULV	Upper Lee Valley
WID	Waste incineration directive

PARSONS BRINCKERHOFF

EXECUTIVE SUMMARY

Introduction	The NLSA commissioned Parsons Brinckerhoff to conduct CHP feasibility studies in Haringey addressing both the potential to install stand-alone prime-movers, and also the potential to connect these 'satellite' clusters of demand to the emerging Upper Lee Valley Decentralised Energy Network (ULV DEN).
Tottenham Green	The analysis illustrates that the heat load density of the existing loads in the immediate vicinity of Tottenham Green is not sufficient to warrant the installation of a new energy centre with CHP under a power export scenario. The addition of the loads of the Lawrence Road and Turner Avenue developments (alongside a contribution from both of these schemes towards the capital cost of the insfrastructure) mean that the scheme displays at positive net present value at low discount rates. It is recommended that other avenues are explored to give greater financial security to a kick-start network at Tottenham Green. One means of further improving performance would be to increase the value of electricity generation over the 'export to grid' scenario. It is calculated that with an increase of value for power generation of 1.5p/kWh over the export-only scenario, that the scheme would display a positive net present value at a more 'commercial' discount rate of 12%. This cluster of loads forms an important part of the linking chain of loads to take the wider Upper Lee Valley DEN toward the cluster of high density demands at Tottenham Hale and beyond. Hence it is considered of significant value both to Haringey and to the wider DEN that this scheme is supported, and the electricity licence lite investigated with a view to creating a 'bankable' kick-start scheme.
White Hart Lane	The White Hart Lane (aka Northumberland Park Development) scheme has been modelled both under the scenario of taking a heat supply from the DEN, and also as a scheme operating its own gas-fired CHP units. The analysis illustrates that under both CHP and DEN scenarios, the scheme returns positive whole life costs at all discount rates analysed (3.5% to 12%). These positive results are based around the developer bearing the costs of on-site network infrastructure for the distribution of heat. The option of connecting to the wider ULV DEN delivers the most positive NPV of all the options. The analysis has been cross-checked with the main DEN analysis in terms of the heat sales price make-up and volumes, and the overall balance of income is comparable. This corroborates the main DEN analysis. The DEN whole life cost analysis result draws its boundary around the White Hart Lane system, and therefore the positive whole life cost results must also be considered in the light of contributing to the overall cost of the DEN installation to enable the heat supply to be made available to the White Hart Lane system.
Hale Village	The Hale Village complex is currently supplied with heat from a Dalkia-operated energy centre. This is a 25-year concession agreement, and the commercial incentive to take heat from the DEN will arise only if it appears that Dalkia can purchase cheaper heat from the DEN than they can produce

	themselves at their own energy centre. Their own energy centre contains biomass boilers (benefiting from RHI support), thermal storage, and it is understood that a small CHP engine is also to be installed in the near future. This will generate low cost heat and it is considered unlikely that the DEN can offer a substantial enough cost-saving margin over this existing installation in order to attract commercial interest from Dalkia in the short-term, particularly during the span of the RHI support. It is suggested that when RHI support for the generation of heat from biomass expires in around 2029, there may be an opportunity to attract commercial interest in the DEN extension.
Conclusion	The analysis conducted as part of this satellite study is important in corroborating the wider DEN analysis for the Upper Lee Valley. The finding of both reports (this satellite scheme report and the wider DEN report) point towards the importance of White Hart Lane as a key load in the ULV DEN. The results for the Tottenham Green scheme illustrate that the stand-alone CHP options are marginal in terms of economic performance, and that connection of all identified loads is required in order to render the scheme viable. In order for a more deliverable kick-start scheme to emerge, an increase in electricity export value would have very significant benefit. Hence for this scheme, it is recommended that mechanisms such as the electricity licence lite are pursued alongside discussions with key developers and existing heat demand customers.
This sheet is intended as a summary only	

1 INTRODUCTION AND STRATEGIC CONTEXT

1.1 Background and scope

1.1.1 The North London Strategic Alliance (NLSA) has commissioned Parsons Brinckerhoff Energy Solutions (PBES) to conduct a series of combined heat and power (CHP) feasibility studies in Haringey and Waltham Forest.

1.1.2 There are two key objectives of these studies:

- To investigate the short-term viability of CHP installation
- To inform the potential development of the Upper Lee Valley (ULV) Decentralised Energy Network (DEN)

1.1.3 This feasibility study into the potential to install gas-fired CHP in the areas surrounding Tottenham Green, White Hart Lane and Hale Village is based around site surveys of the area, and analysis of the environmental and economic benefit that the technology could deliver. Consideration has been given to the means of mechanical and electrical integration of the plant, as well as delivery and programme.

1.1.4 This study does not address delivery vehicles and financing for the project. These aspects of implementation are being considered in a separate work stream being undertaken by the GLA.

1.2 Strategic context

1.2.1 The following map illustrates (on an indicative basis only) the ULV DEN concept being developed in conjunction with these local feasibility studies.

Figure 1-1 DEN Strategic Overview

1.2.2 This map shows the location of the initial primary heat source of the DEN (Edmonton Incinerator), broad indications of the proposed directions for the strategic network growth.

1.2.3 This map illustrates the comparative location of the various satellite schemes being analysed by PBES, and also shows the location of CHP schemes being investigated by the GLA.

1.2.4 PBES is investigating CHP feasibility at:

- Tottenham Green
- Northumberland Park (White Hart Lane)
- Tottenham Hale Village (site-wide DH and low-carbon plant already installed – PBES investigating potential to connect to DEN at a later date)

- Blackhorse Lane (LB of Waltham Forest)
- Walthamstow Town Centre (LB of Waltham Forest)

1.2.5 The GLA / Decentralised Energy Project Delivery Unit (DEPDU) are investigating CHP feasibility at:

- Waltham Forest Town Hall (LB of Waltham Forest)
- Wood Street AAP (LB of Waltham Forest)

2 TOTTENHAM GREEN SATELLITE SCHEME

2.1 Outline of approach

2.1.1 The Tottenham Green scheme could be operated (in terms of energy supply) in a number of ways. This report provides LB Haringey with some guidance on the impacts of various approaches to governance of the energy supply elements of the development.

2.1.2 The scenarios examined are:

- Private sector Energy Services Company Supply (from site-based energy centre) (base case)
- Public sector-led Energy Services Company Supply (from site-based energy centre)
- And a base case (from local gas boilers)

2.1.3 The cost elements of the two energy company options are considered to be identical, but the public-sector led ESCo is assumed to have access to lower cost finance, and is able to contemplate a longer-term return on investment than the private sector equivalent.

2.2 Loads considered

2.2.1 The Tottenham Green satellite scheme is centred around the cluster of public buildings located at the former town hall building. The location is bounded by a rail line to the west, the A10 High Road to the east, Phillip Lane to the north and the A503/4 to the south. This section outlines the buildings and developments considered in this immediate and surrounding area.

2.2.2 PB undertook a desktop survey supported by site visits to the public buildings identified. Presented below are the buildings and sites considered either now or in the short to medium term for connection.

2.2.3 The following buildings were considered:

In the central area around Tottenham Green:

- College of North East London (CONEL)
- Tottenham Green Leisure Centre
- Bernie Grant Arts Centre
- Tottenham Town Hall Building

To the west of Tottenham Green the following properties owned by Homes for Haringey were considered:

- Blenheim Rise
- Cordell House
- Markfield House
- Sophia House
- St Peters House
- Stamford House

2.2.4 The following development opportunities were considered.

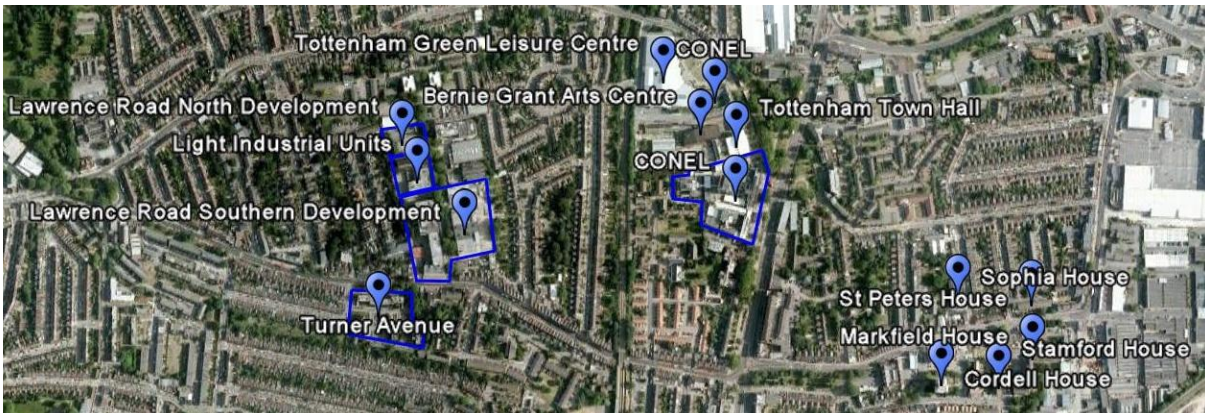
In the central area around Tottenham Green the Bus Station Depot is considered to be a medium term development opportunity.

To the west of Tottenham Green the land either side of Lawrence Road is to be developed with:

- 250 homes and mix of commercial and retail space. A planning application is expected from the developer in summer 2012 (southern end of development area).
- 30 home development and the potential development of two light industrial units (northern end of the development area).
- South of Lawrence Road the housing block located at Turner Avenue is anticipated to be demolished and rebuilt in the medium term. This potential development will be included as an option in this study based on 200 units which are a mix of 1, 2 and 3 bedroom flats.

2.2.5 The following map illustrates the buildings and development areas considered:

Figure 2-1 Tottenham Green Satellite Scheme[1]



2.3 Information received

2.3.1 The desktop survey analysis was supported by mapping data made available by Haringey Council in relation to the housing stock owned by Homes for Haringey.

2.3.2 The council's energy management department supplied the monthly gas consumption data for the majority of the public buildings identified. Where this data was not held by the council the information was sought from contacts provided by the council.

2.3.3 Gas consumption for the Homes for Haringey properties identified is taken from Haringey Council's submission to the London Heat Map. Haringey Council provided their original submission to this project.

[1] Homes for Haringey properties are identified by the HfH four digit number.

2.3.4 Information on the Lawrence Road developments was based on Haringey's Council latest understanding of each developer's intentions and their own long term plans. This was informed in part by energy strategy report prepared for the council by others.

2.4 Heat demand

2.4.1 Based on the buildings identified and energy data received, the annual heat demand for each building was developed and is presented in the tables below.

2.4.2 Where monthly gas consumption information was available the data was corrected for boiler efficiency and degree day corrected to 20 year average values. The degree day analysis was also used to calculate the split between variable (i.e. space heating) and baseload (i.e. hot water) demand.

2.4.3 Annual gas consumption data for the social housing stock was made available. This data was converted to heat and split between space heating and hot water.

2.4.4 Energy data for new developments was based on recognised benchmarks with an improvement factor applied to account for the anticipated improvement in building energy efficiency required by current and future building regulations.[2]

Table 2-1: Annual Heat Demand for Tottenham Green Non-Domestic Loads

Property	Year Available	Annual Heating Demand (kWh)	Variable / Space Heating Proportion	Baseload / Hot Water Proportion
Tottenham Green Leisure Centre	2014	2,194,442	48%	52%
College of North East London	2014	1,780,340	75%	25%
Bernie Grant Arts Centre	2014	205,113	81%	19%
Tottenham Town Hall	2014	380,542	81%	19%

Table 2-2: Annual Heat Demand for Homes for Haringey Properties

Property	Year Available	Annual Heating Demand (kWh)	Variable / Space Heating Proportion	Baseload / Hot Water Proportion
Blenheim Rise	2014	406,105	75%	25%
Cordell House	2014	343,894	75%	25%
Markfield House	2014	336,253	75%	25%
Sophia House	2014	260,443	75%	25%
St Peters House	2014	229,078	75%	25%
Stamford House	2014	337,686	75%	25%

[2] CIBSE TM44 – 2008 for commercial and retail developments and NHER Housing Benchmarks for the BRE Standard Domestic Property Suite for Residential Developments.

Table 2-3: Annual Heat Demand for Lawrence Road Development and Turner Avenue

Property	Year Available	Annual Heating Demand (kWh)	Variable / Space Heating Proportion	Baseload / Hot Water Proportion
Residential - North	2013/14	161,803	60%	40%
Residential - South	2014/15	1,342,285	60%	40%
Commercial - North	2014	30,101	85%	15%
Commercial - South	2014/15	60,201	85%	15%
Turner Avenue	2016/16	755,793	62%	38%

Table 2-4: Annual Heat Demand Load Summary

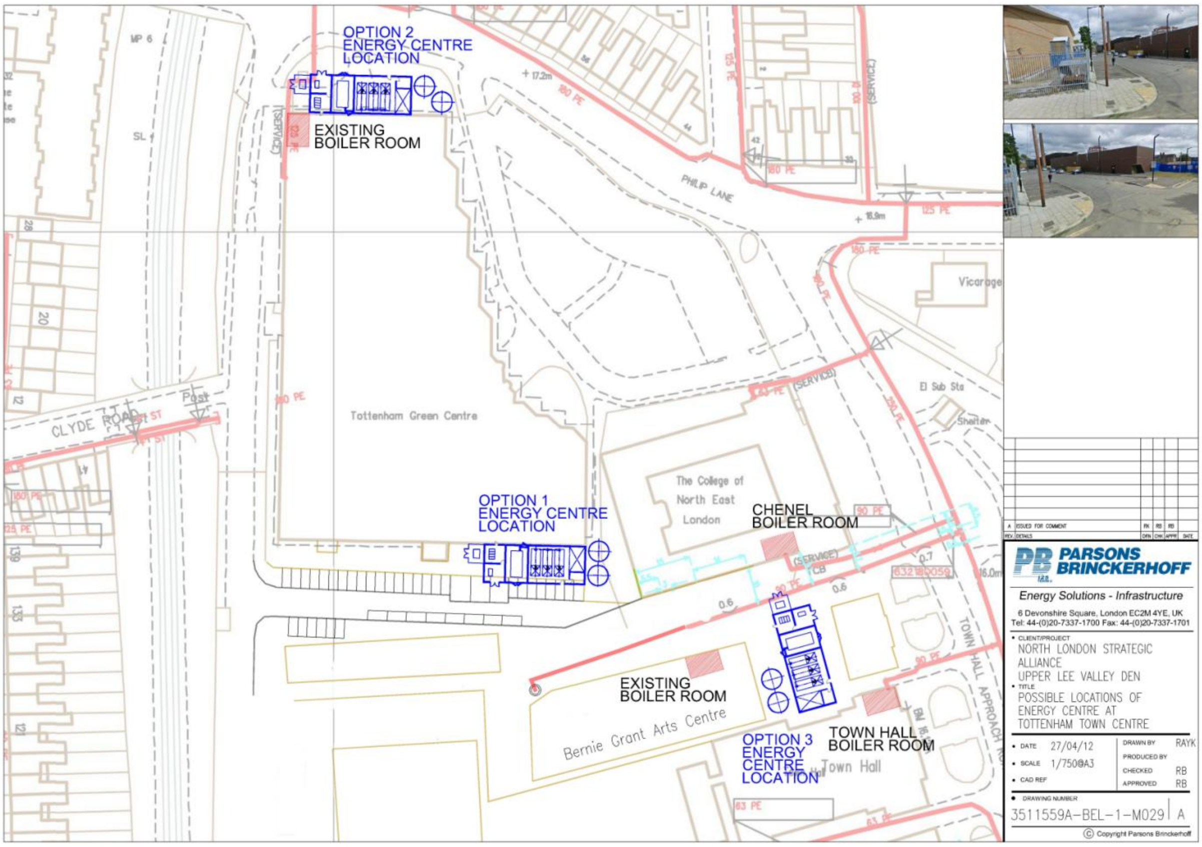
Property	Annual Heating Demand (kWh)	Variable / Space Heating Proportion	Baseload / Hot Water Proportion
Tottenham Green Non-Domestic Loads	4,560,436	63%	37%
Homes for Haringey Loads	1,913,460	75%	25%
Lawrence Road	1,594,390	62%	38%
Lawrence Road including Turner Avenue	2,350,183	62%	38%

2.5 Location of energy centre

2.5.1 Three potential locations have been identified as a potential location for an energy centre incorporating a CHP. They are presented in drawing M029 (see appendices and small version below) and are:

- At the northern end of Tottenham Green Leisure Centre.
- At the southern end of Tottenham Green Leisure Centre
- Behind the front Bernie Grant Arts Centre Building

Figure 2-2 Potential Energy Centre Locations (Tottenham Green)



2.5.2 Option 1 at the southern end of Tottenham Green leisure centre would make use of the space towards the south east of building.

2.5.3 Option 2 at the northern end of Tottenham Green Leisure Centre would make use of the space between the leisure centre and Phillip Lane. Space would be tight and access would be restricted. Some incorporation of plant or ancillaries within the leisure centre may be possible.

2.5.4 Option 3 is a square behind the Bernie Grant Arts Centre building on Town Hall Approach Road. The location is compact and here again there may only be restricted access possible, which lead to difficulties for installation of major plant items.

2.5.5 Locating an energy centre in in the Option 3 area will be difficult because of the central location, although this also makes it ideal for minimising district heating pipework costs. Whichever location is chosen the size of the building footprint and the location of the thermal store[3] will be constrained by the space available.

2.5.6 A final additional option would be to site the energy centre at Lawrence Road and use one of the light industrial locations identified for the energy centre. This would mean the connection of all loads defined in this area although there would be the loss of a small heat load from the one light industrial unit occupied.

2.5.7 The Option 1 energy centre location at the southern end of Tottenham Green Leisure Centre is the option is perceived by PB to be the most viable of those presented. It is centrally located providing immediate connection to four boiler rooms, has good access and is screened on all sides.

2.6 District heating routing

2.6.1 A least cost route is required to connect these loads. Based on the preferred energy centre location identified above at the south end of Tottenham Green Leisure Centre, one connection pipe would branch out from the energy centre to serve the leisure centre and another to serve the other loads. The second pipe would strike out towards the Town Hall Approach Road with branches serving the northern Conel building, Bernie Grant Arts Centre and Tottenham Town Hall. This pipe would then route down the Town Hall Approach Road to service the southern Conel buildings.

2.6.2 To serve the Lawrence Road development the flow and return pipework would extend down the High Road and turn on to West Green Road. Once Lawrence Road is reached the pipework continues on for 100m to terminate at Turner Avenue. Using this route the pipework will cross underneath the rail line which runs west of the high road.

2.6.3 To serve the Homes for Haringey Properties identified the pipework would branch from the High Road and route down Broad Lane branching off to serves each property.

2.6.4 The district heating route described above is presented in the figure below. The route cannot practically avoid running on the High Road but is only on the road for approximately 225m and as previously described only crosses the rail line once.

2.6.5 In the medium term if the bus depot on Phillip Lane is developed connection to the central trunk pipe is only a short distance.

[3] These vessels maximise CHP runtime by capturing excess heat for later discharge into the network at times of high demand or when the CHP is not running.

Figure 2-3 Tottenham Green Satellite Scheme

2.7 Connection viability test

2.7.1 PB has adopted a two-stage modelling process. The first stage tests the viability of the various connections at a very high level in order to scope the loads taken forward for further testing. The second stage then goes into more detailed modelling to confirm the performance of different schemes considered to have potential to be viable. This section describes the first stage, high-level viability test carried out.

2.7.2 After the load of each connection was ascertained PB conducted a high level connection assessment to determine the viability of connecting the Lawrence Road developments and the Homes for Haringey Loads to the central cluster.

2.7.3 The high level test is based on the net revenue potential for each load discounted using the HM Treasury social discount rate of 3.5% to pay back the incremental cost of connection (including the cost of the district heating pipework and building conversion cost). The test includes a one off cost saving for social housing and public sector loads from the displaced need to replace a gas-fired boiler.[4]

2.7.4 The table below shows the connection cost and high level payback period for connecting the Lawrence Road developments, Turner Avenue and the Homes for Haringey properties to the central scheme. The connection of the Lawrence Road developments and Turner Avenue assumes there are no building conversion costs (i.e. the development is ready to accept district heating). In addition it is assumed that the developers of Lawrence Road and Turner Avenue provide a contribution to enable the development to connect to the district heating scheme.

2.7.5 To emphasise the importance of obtaining a developer contribution the connection of the Lawrence Road and Turner Avenue developments is shown with and without a developer contribution to the cost of the network connection.[5] A developer contribution in this instance could reflect the avoided cost of installing low-carbon energy plant.

2.7.6 Finally, for the Lawrence Road development connection assessment an additional option of connecting Blenheim Rise (located on the corner of High Road and Broad

[4] Residential avoided cost £1,250, Non Residential avoided cost £35 per kW installed capacity.
[5] Developer contribution assumed to be £1,750 per residence.

Lane) is shown. As the building lies on the route it is a potentially viable connection due to the short distance. It is a costly connection on its own terms and its inclusion in the scheme extends the overall payback by 2 years.

Table 2-5: Connection Viability Assessment – Lawrence Road Developments

Property	Connection Cost	Payback Period (Years)
Without Developer Contribution		
Extending Connection from CONEL to the Lawrence Road Developments	£1,024,400	n/a
Extending Connection from Lawrence Road to the Redeveloped Turner Avenue	£108,350	8
With Developer Contribution		
Extending Connection from CONEL to the Lawrence Road Developments	£325,000	23
Extending Connection from Lawrence Road to the Redeveloped Turner Avenue	(£241,650)	0
Summary		
Lawrence Road and Turner Avenue with Developer Contribution	£292,750	7
Including HfH Blenheim Rise	£443,050	9

2.7.7 The table below shows the connection cost and high level payback period for connecting the Homes for Haringey properties identified to the central scheme.

2.7.8 Connecting the Homes for Haringey properties directly to the central scheme is not viable and connecting them to a spur from the trunk serving the Lawrence Road developments results in an unfeasibly long payback period (including property conversion costs).

Table 2-6: Connection Viability Assessment – Homes for Haringey Properties

Property	DH Connection & Conversion Cost	Payback Period (Years)
Connecting to spur from Lawrence Road Connection	£1,104,700	81

2.7.9 One option to improve the scheme payback would be if in addition to the assumed avoided cost incorporated in this analysis, the cost of conversion is funded from another source such that the revenue from the connection would only be required to fund the initial district heating link.

2.7.10 From this assessment two schemes have been taken forward for more detailed energy balance and financial modelling:

- Central scheme

   - Comprising the public sector building loads

- Central and West

   - As above plus the Lawrence Road and Turner Avenue developments and Homes for Haringey's Blenheim Rise. The connection of the new developments will assume a developer contribution is forthcoming.

2.8 Plant room interfaces

2.8.1 Each of the existing buildings for the proposed central scheme was visited to evaluate how district heating could be routed to the boiler room and to assess the compatibility of the existing system with a district heating connection.

2.8.2 For each building a description of the boiler room and its location is available in appendix 6.2. A detailed map showing the location of the boiler rooms and an indicative schematic showing where the district heating interface would connect into the existing system is shown in appendix 6.4.

2.9 Electrical connection

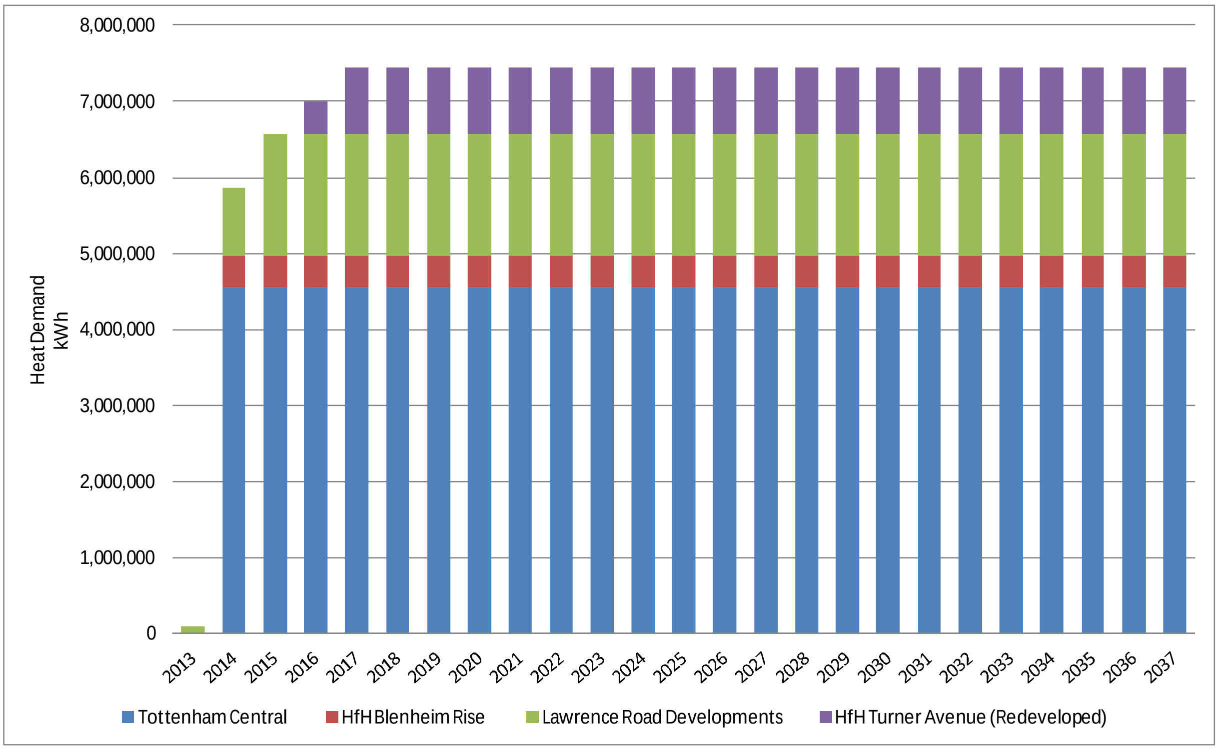
2.9.1 PB has held discussions with UK Power Networks, the local district network operator, on the suitability of the local electrical infrastructure to accept a connection from the proposed CHP unit.

2.9.2 At the time of writing UKPN have responded with an initial quotation of £150,000 to connect and reinforce the local grid to accept the export from the energy centre. PB would recommend that this initial quotation is further pursued at the next stage of project design, in order to understand the basis for this figure in greater detail.

2.10 Load projection

2.10.1 Based on the timeline presented in the previous sections the figure below shows the load build up.

Figure 2-4: Heat Load Projection



2.11 Modelling methodology

2.11.1 This section describes the more detailed modelling carried out on those loads that appeared to have potential to be viable (from the high-level viability test described in Section 2.7).

2.11.2 PB has constructed hourly profiles for the demands of each connection for the three clusters central, west and east. These loads form one of the bases of the modelling approach adopted in this project.

2.11.3 The heating loads are entered into the low carbon energy options analysis tool to model the operation of different low carbon energy supply configurations. We have used this to assess the operational performance and hence viability of different sizes and configurations of plant. The key inputs to the model are the energy demand profiles (see below) and the operating performance characteristics of the CHP and gas boiler units; this information is contained in an extensive database that PB has built up covering a wide range of plant types and capacities (from 10's of kWe to multi-MWe units).

2.11.4 The outputs from the model include fuel consumption and capital cost, maintenance costs, top-up and standby boiler fuel use and cost, electricity generated and cost of imported power. The model also quantifies the emissions from the CHP plant and boilers, and those associated with the imported power.

2.12 Options considered

2.12.1 PB has modelled three heat supply options – two CHP district heating options and a base case in which heat is supplied to each building by on-site gas boilers (either the existing plant where applicable, or new plant for new development). In all new build options, gas boilers have been sized to meet peak demand such that there is resilience at all times.

2.12.2 To determine the CHP engine sizes to present in this study, PB used a simple rule of thumb as a starting point – that the engine acting as lead unit should serve the majority of the heating demand whilst achieving at least 5,000 to 5,500 annual operating hours.[6] Thermal storage was included in the two decentralised options to allow for increased utilisation of the CHP.

2.12.3 The table below presents the energy centre main plant items configurations for the two scheme scenarios modelled. Each scheme scenario is presented with two sizes of CHP units.

[6] This is based on 17 hour per day operation and a 92% level of availability.

Table 2-7: Energy Centre Main Plant Item Configuration

	Option A Base Case	Option B CHP	Option C CHP
Central Scheme			
CHP Electrical Output (kW$_e$)	n/a	425	500
CHP Thermal Output (kW$_{th}$)	n/a	468	527
Thermal Store Size (m^3)	n/a	50	50
Gas Boilers (kW$_{th}$)	n/a	5,500	5,500
Central and West Scheme			
CHP Electrical Output (kW$_e$)	n/a	635	888
CHP Thermal Output (kW$_{th}$)	n/a	766	972
Thermal Store Size (m^3)	n/a	50	50
Gas Boilers (kWth)	n/a	7,000	7,000

2.13 Capital cost estimates

2.13.1 The capital cost estimates each for each configuration described above is presented in the table below.

Table 2-8: Capital Cost Estimates

		Option A Base Case	Option B 425kWe	Option C 500kWe
Central Scheme				
CHP		£0	£363,487	£386,772
Boilers		£0	£467,500	£467,500
Thermal Store		£0	£55,000	£55,000
EC Building		£0	£375,000	£375,000
DH Network		£0	£514,225	£514,225
Non-Residential	Conversion Cost	£0	£240,000	£240,000
	Avoided Cost e.g. new boilers	£210,000		
Total		**£210,000**	**£2,015,212**	**£2,038,497**
Central and West Scheme				
CHP		£0	£655,000	£865,000
Boilers		£0	£595,000	£595,000
Thermal Store		£0	£75,000	£75,000
Energy Centre Building		£0	£375,000	£375,000
DH Network		£0	£1,709,775	£1,709,775
Non-Residential	Conversion Cost	£0	£240,000	£240,000
	Avoided Cost	£210,000		
Developer Contribution	Lawrence Road Developments		(£490,000)	(£490,000)
	Turner Avenue		(£350,000)	(£350,000)
HfH Blenheim Rise	Conversion Cost		£150,000	£150,000
	Avoided Cost	£62,500		
Total		**£272,500**	**£1,629,775**	**£1,419,775**

2.14 Maintenance and annual cost assumptions

2.14.1 The following maintenance and annual costs assumption were made for the base case:

- Residential gas boiler maintenance £150[7]
- Non residential plant room service cost £2,000 per plant room

2.14.2 The following maintenance and annual cost assumptions have been made:

- CHP maintenance costs at 1.2 p/kWh
- Energy centre maintenance costs 1% of capital expenditure
- District heating network maintenance costs 1% of capital expenditure
- £500 per annum per non-residential connection for billing and invoicing.
- £150 per annum per non-residential connection for billing, invoicing and HIU maintenance.

Table 2-9: Maintenance Costs

	Option A Base Case	Option B 425kWe	Option C 500kWe
Central Scheme			
CHP		£26,586	£30,531
Domestic Gas Boiler Maintenance			
Non-Domestic Plant Room Maintenance	£8,000		
Invoicing and Billing		£4,000	£4,000
Energy Centre		£8,975	£8,975
DH Network		£5,142	£5,142
Total	**£8,000**	**£44,703**	**£48,648**
Central and West Scheme			
CHP		£39,879	£51,797
Domestic Gas Boiler Maintenance	£28,800		
Non-Domestic Plant Room Maintenance	£8,000		
Invoicing and Billing		£32,800	£32,800
Energy Centre		£10,250	£10,250
DH Network		£17,098	£17,098
Total	**£36,800**	**£100,027**	**£111,945**

[7] Cost advised by Homes for Haringey – 9th May 2012

2.15 Replacement cost assumptions

2.15.1 CHP engines typically have an operating life of approximately 80,000 hours. Based on annual operating hours modelled the engines shown would be replaced in year 15.

2.15.2 The energy centre gas boilers are assumed to be replaced in year 20.

2.15.3 All other major assets are assumed to have a life expectancy exceeding the whole life costing period of 25 years.

2.15.4 The base case assumes non-residential gas boiler are replaced every 15 year and residential gas boilers every 15 years.

2.16 Utility and heat prices

2.16.1 In order to ensure that there is a comparable basis between satellite schemes, a single set of utility price assumptions has been adopted in modelling of plant operation.

2.16.2 PBES has adopted the view that currently contracted utility prices do not necessarily form an indicative basis of future prices. We are going through a period of significant volatility in energy markets, both in terms of physical generation assets changing and regulation developing to support the low-carbon agenda. On this basis, the DECC forward projections (October 2011) of energy prices as listed in the appendix 6.3 of this report have been adopted in modelling.

2.16.3 The table below outlines which data series is used for each energy stream in the modelling.

Table 2-10: Energy Stream Data Series

<table>
<tr><th>Energy Stream</th><th>Series Used</th><th>Adjustment Applied</th></tr>
<tr><td>Energy Centre Gas</td><td>Industrial</td><td rowspan="3">None</td></tr>
<tr><td>Energy Centre Electricity Export</td><td>Wholesale</td></tr>
<tr><td>Energy Centre Electricity Import</td><td>Residential</td></tr>
<tr><td>Commercial Price for Heat</td><td>Service Gas Price</td><td rowspan="2">1st Gas Boiler Efficiency
2nd 10% Discount for Public Buildings and Social Tenants
3rd p/kWh Standing Charge</td></tr>
<tr><td>Residential Price for Heat</td><td>Residential Gas Price</td></tr>
</table>

2.16.4 As indicated in the table above the sale price of heat to end users is made up of three elements; a correction for gas boiler efficiency, a 10% discount on the resulting sale price (if applicable) and a p/kWh standing charge.

2.16.5 The standing charge element ensures the consumer of the heat is contributing to maintenance of the network and administration of their account. This charge has been set at 0.25 p/kWh for commercial customers and 2 p/kWh for residential customers.

2.16.6 The table provides an example for the year 2020 of the price make up for the four categories of consumers.

Table 2-11: Heat Sales Price Build Up for Existing and New Connections in 2020

	Commercial		Residential	
	Existing	New	Existing	New
Services Gas Price	3.65	3.65	5.08	5.08
Boiler Efficiency	80%	80%	83%	83%
Heat Price	4.56	4.56	6.13	6.13
Heat Sales Discount	10%	n/a	10%	n/a
Heat Price After Discount	4.11	n/a	5.51	n/a
Standing Charge Element	0.25	0.25	2.00	2.00
Heat Sales Price	4.36	4.81	7.51	8.13

2.17 Results – central scheme

2.17.1 PB modelled the performance of the two CHP options against the base case of individual gas boilers. The performance of the CHP units modelled is shown in the table below.

Table 2-12: Central Scheme CHP Results

	Option B 425kWe	Option C 500kWe
CHP Operating Hours	5,306	5,224
CHP Heat	50%	55%
Boiler Heat	50%	45%

2.17.2 The economic results are presented for a range of discount rates. In all cases, the DECC central utility price scenario was used (see Section 2.15), and electricity export is valued at wholesale electricity price.

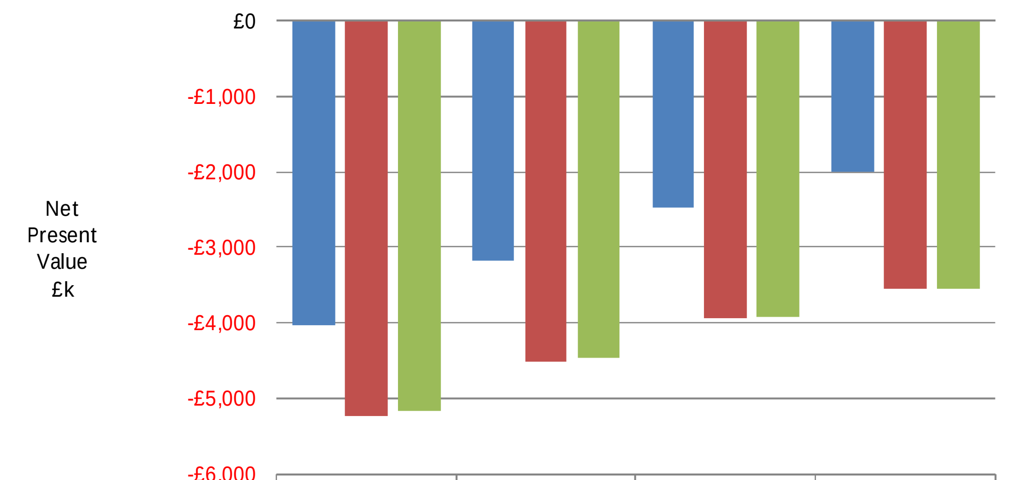
2.17.3 Results are presented for in two ways:

- First, in terms of the cost of heat generation, i.e. without the inclusion of heat sales. This illustrates which method of heat generation (business as usual or CHP) is an overall least-cost solution.
- Second, a more commercial approach is modelled for the CHP options, where the heat sales to customers from the central energy centre are evaluated in terms of their ability to recoup the expense of the initial installation.

2.17.4 The table and figure below shows the difference between the cost of heat generation for CHP options compared to the base case at a range of discount rates.

2.17.5 This graph shows how the district heating options cost more to operate than individual gas boilers at all discount rates over the 25 year project lifetime. As the discount rate increases, the performance against the base case worsens as a result of the decreasing value of future annual operating cost reductions, such that it cannot offset the capital cost of the DH network.

Figure 2-5: Central and West Scheme – Comparison of the Cost of Heat Generation

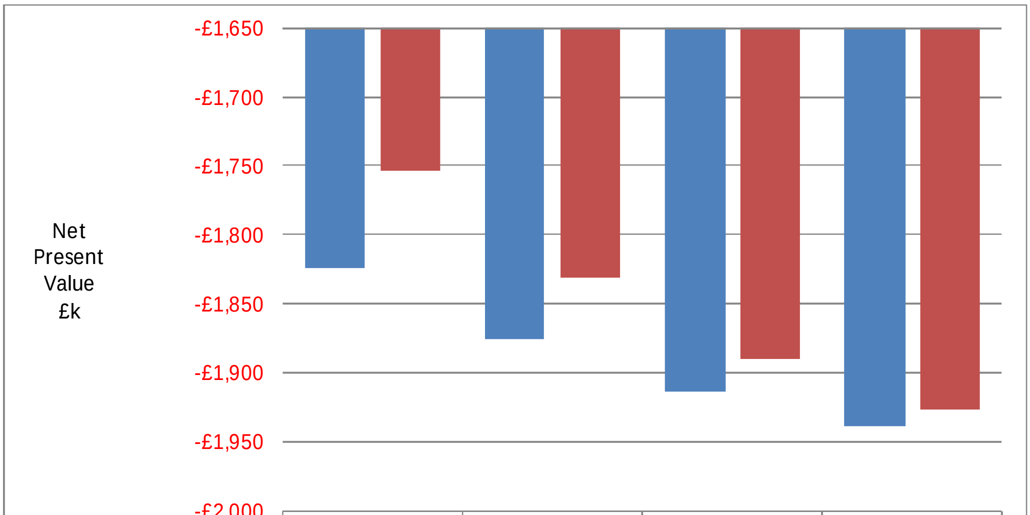


	3.5%	6.0%	9.0%	12.0%
Option A - Basecase	-£4,042	-£3,170	-£2,473	-£2,010
Option B - 425kWe CHP	-£5,229	-£4,514	-£3,940	-£3,556
Option C - 500kWe CHP	-£5,159	-£4,470	-£3,916	-£3,545

2.17.6 The figure below shows the commercial performance of the two district heating options modelled over the 25 year project lifetime, i.e. including heat sales.

2.17.7 This graph shows how a district heating network exporting to the grid cannot generate a positive net present value even at a low discount rate.

Figure 2-6: Central and West Scheme – Net Present Value Performance of District Heating Options Modelled.



	3.5%	6.0%	9.0%	12.0%
Option B - 425kWe CHP	-£1,824	-£1,875	-£1,914	-£1,938
Option C - 500kWe CHP	-£1,753	-£1,831	-£1,889	-£1,927

2.17.8 These results show that, based on the heat demands modelled, there does not appears to be a viable scheme at based on the Central clusters under current market conditions.

2.17.9 One key means, through which this economic performance could be significantly improved, is through increasing the value of export power. The 'licence lite' is a potential route for this to be realised. The results of sensitivity analysis around electricity export price increase are presented after the Central and West scheme results (at standard wholesale prices).

2.18 Results – central and west scheme

2.18.1 The performance of the CHP units modelled is shown in the table below for the Central and West scheme (i.e. including the Lawrence Road and Turner Avenue developments).

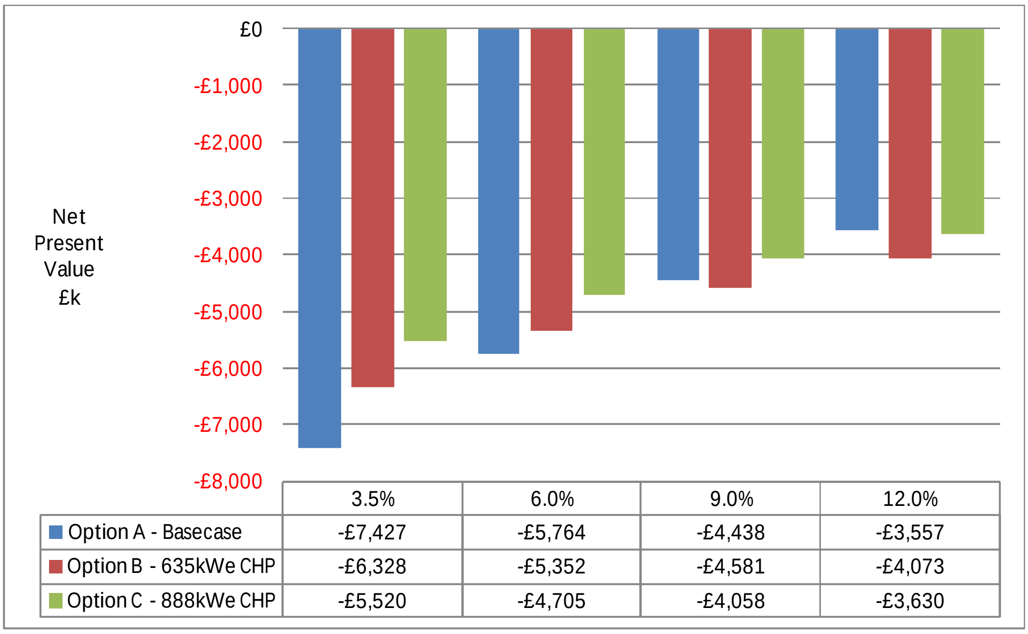
Table 2-13: Central and West Scheme CHP Results

	Option B 635kWe Engine	Option C 888kWe Engine
CHP Operating Hours	5,343	5,113
CHP Heat	50%	59%
Boiler Heat	50%	41%

2.18.2 The economic results are presented for a range of discount rates. In all cases, the DECC central utility price scenario was used (see Section 2.14).

2.18.3 This graph shows how it is (in whole life terms) less costly to generate heat via the CHP district heating options rather than under the base-case individual gas boiler at low discount rates over the 25 year project lifetime. As the discount rate increases the cost of district heating heat is similar to the gas boiler base-case.

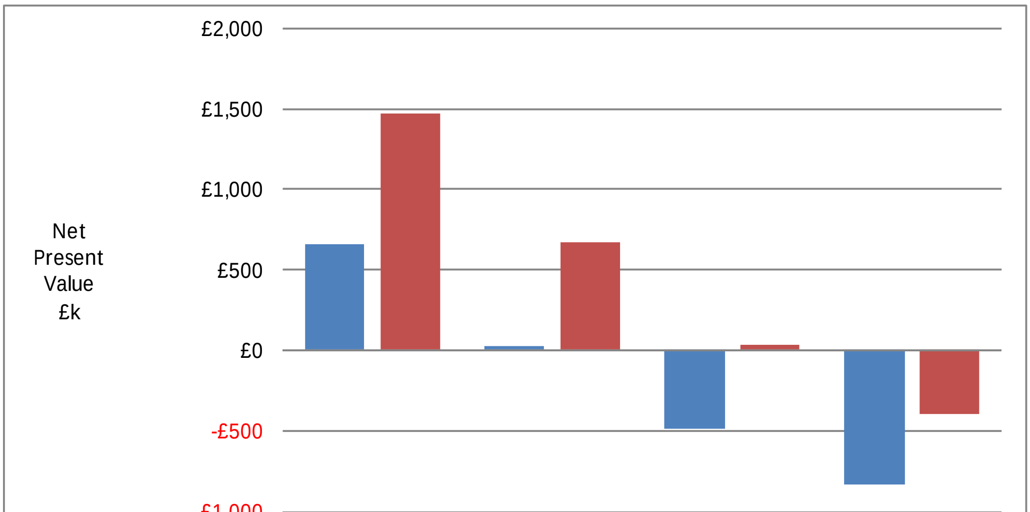
Figure 2-7: Central and West Scheme – Comparison of the Cost of Heat Generation



2.18.4 The figure below shows the commercial performance of the two district heating options modelled over the 25 year project lifetime, i.e. including heat sales.

2.18.5 This graph shows how a district heating network exporting to the grid at wholesale market values generates a positive net present value at a low discount rates (including developer contributions).

Figure 2-8: Central and West Scheme – Net Present Value Performance of District Heating Options Modelled.



	3.5%	6.0%	9.0%	12.0%
Option B - 635kWe CHP	£660	£23	-£492	-£840
Option C - 888kWe CHP	£1,468	£671	£31	-£397

2.18.6 These results show how, based on the heat demand developed and the options modelled, there appears to be a viable scheme based on the Central and West clusters, if a scheme can be financed at a low discount rate (i.e. supported by the public sector).

2.18.7 The key to making the central and west cluster scheme succeed is the extension of the Lawrence Road connection to include 200 units from the redeveloped Turner Avenue for a small cost and obtaining a contribution towards the infrastructure installation cost from thethese developments.

2.19 Electricity export price sensitivity

2.19.1 The following section examines the impact on the results shown above (in particular to test whether the cost of heat generation can be reduced for the CHP / DH scenarios to a level below the business-as-usual case) from varying electricity export values. These values represent ‘base’ 2012 values, and thereafter export prices are modelled to vary following the same trend as electricity retail prices.

2.19.2 The table below presents the net present value benefit at 12% discount rate to the project over 25 years for each additional 0.5p/kWh of additional financial benefit that can be obtained from the value of the exported electricity.

Table 2-14: Financial Benefit of Capturing Additional Value from Exported Power (£k NPVs at 12% discount) [8]

	Electricity Export Price	Option B	Option C
Central		**425kWe Engine**	**500kWe Engine**
NPV at Average Wholesale Export Value	8.82 p/kWh	(£1,938)	(£1,927)
NPV at Average Wholesale Export Value Plus the Realisation of Additional Value of	0.5 p/kWh	(£1,855)	(£1,830)
	1.0 p/kWh	(£1,771)	(£1,733
	1.5 p/kWh	(£1,687)	(£1,637)
Central and West		**635kWe Engine**	**888kWe Engine**
NPV at Average Wholesale Export Value	8.82 p/kWh	(£840)	(£397)
NPV at Average Wholesale Export Value Plus the Realisation of Additional Value of	0.5 p/kWh	(£714)	(£232)
	1.0 p/kWh	(£587)	(£67)
	1.5 p/kWh	(£461)	£98

2.19.3 This table illustrates the whole life cost results of both extents of scheme analysed around Tottenham Green. The table shows that in order for the more viable 'Central and West' configuration to achieve a 'commercial' return (i.e. a positive NPV at a 12% discount rate), the export value of the larger engine needs to be increased by 1.5p/kWh over the DECC projected wholesale values modelled under the 'normal' scenarios.

2.19.4 It is beyond the scope of this project to determine the means through which higher electricity export prices could be obtained. However, potential outline mechanisms for sale are understood to be as follows;

a) Wholesale export – this would assume that power exported to grid would be valued at wholesale electricity prices.

b) Retail sale - 'netting off' - this would assume different sales rates according to local customer type, and would divide total electricity sales across these customers types by volume of demand. It is proposed that the customer types considered would be residential customers (social housing only), office / administration / leisure (Council-controlled premises), and large organisations.

c) Supply licence – 'licence lite' arrangements are understood to be not fully developed at this stage. This option simulates the sale of electricity via the licence-lite route to a single large user (e.g. GLA / TfL).

d) Sale of electricity to a single large organisation via private wire.

[8] NPV values presented are at 12% over 25 years.

2.20 Emissions analysis

2.20.1 Emissions projections for the schemes analysed have been calculated on the basis of the emissions factors contained within the current Building Regulations approved documents[9]. These are:

Table 2-15 Emissions Factors

Fuel type	Emissions factor ($kgCO_2$ / kWh)
Mains gas	0.198
Heating oil	0.274
Wood chips	0.009
Wood pellets	0.028
Electricity (import)	0.517
Electricity (export)	0.529

2.20.2 The projected emissions savings if the district heating scheme was implemented over the base case of individual gas boilers is:

	Option A Basecase	Option B 635kWe Engine	Option C 888kWe Engine
Central Scheme			
Emissions tCO2	1,129	776	711
Emission Saving		353	418
		31%	37%
Central and West			
Emissions tCO2	1,843	1,153	882
Emission Saving		690	960
		37%	52%

2.20.3 It should be noted that these emissions savings percentages relate to the heating element of energy consumption (i.e. not including emissions from electricity import at the different buildings connected).

[9] Building Regulations Part L2A references the emissions factors with SAP2009, table 12, http://www.bre.co.uk/sap2009/page.jsp?id=1642, accessed January 2012.

2.21 Risks

2.21.1 The following table represents a shortlist of key risks and uncertainties that PBES is currently aware of for the project.

Table 2-16 Key project risks

No.	Risk name	Possible Consequences	Mitigation Action	Score (high, medium, low risk)
1	The avoided costs at Lawrence Road cannot be realised and Developers do not contribute to the cost of connection to district heating scheme	Area either does not connect to central scheme, or does not contribute towards costs of system installation.	Manage programme to try to ensure that developers can benefit from connection to DE system. Review practicality of obtaining a contribution from developer to fund link to central scheme. Potentially suspend requirement for low energy technologies at Development sites for a limited period, whilst waiting for DE link to be developed.	H
2	Central scheme or Central and West scheme are not regarded as financially viable, and funding cannot be obtained.	Neither scheme proceeds.	Review opportunities for private wire supply to public sector loads or 'licence lite' options for increasing power export value Update heat load assessment based on Lawrence Road developers' calculations / plans. Review opportunities for cost savings and / or other potential heat loads.	H
3	Energy centre locations identified are not suitable	No suitable location for energy centre in local area means the likelihood of setting up a viable scheme is reduced.	Review local area for other suitable locations if ones identified are not suitable. Locations could include within new development areas (e.g. Lawrence Road / Bus Depot).	M
4	Commitment is not obtained from existing or development loads, and commercial risk too great to implement scheme	Scheme does not proceed	Manage process of developing commitment from customers, programme for development and set clear objectives for scheme development	H

3 WHITE HART LANE SATELLITE SCHEME

3.1 Outline of approach

3.1.1 The White Hart Lane / Northumberland Park scheme could be operated (in terms of energy supply) in a number of ways. This report considers the impacts of various approaches to governance of the energy supply elements of the development.

3.1.2 The three scenarios examined are:

- Private sector Energy Services Company Supply (from site-based energy centre) (base case)
- Public sector-led Energy Services Company Supply (from site-based energy centre)
- Connection to DEN (avoiding need for energy centre building)

3.1.3 The cost elements of the two energy company options are considered to be identical, but the public-sector led ESCo is assumed to have access to lower cost finance, and is able to contemplate a longer-term return on investment than the private sector equivalent.

3.1.4 The costs / phasing of the Private Sector ESCo base-case has been used to determine a heat sales price to customers on the basis of an assumed required rate of return for the ESCo. The assumed rate of return is 12% over 25 years. The ESCo has been assumed to be responsible for the costs of the energy centre, connectivity to the main development sites and the supply of heat. The cost of the heat distribution network around the development sites is assumed to be borne by the developer.

3.2 Loads considered

3.2.1 The loads considered in this study are located in and around the area in Haringey where White Hart Lane and the High Road intersect. The loads considered fall into five areas:

- Northumberland Development Park
- Cannon Rubber site
- ‘High Road West’ development area
- The Public Sector loads identified
- The Homes for Haringey loads identified.

3.2.2 Northumberland Development Park is the catalyst for the consideration of district heating within the area and is the location where the football club Tottenham Hotspur intend to redevelop their existing stadium and also to deliver a range of commercial, retail and residential opportunities. Information on the development timetable and heat load has been provided by the developers agent.

3.2.3 The Northumberland Development Park is to be developed in three phases.

Phase One is located at the north of the site will be completed by 2013 and includes

- Supermarket
- Office block
- Education facilities

Phase Two is based around the stadium in the centre of the site will be completed by 2016 and includes:

- Stadium
- Hotel
- Retail and restaurants

Phase Three is located at the south of the site will be completed by 2019 and includes:

- Residential units
- Health club
- Health centre
- New education facility

3.2.4 The Cannon Rubber site is located north west of Northumberland Development Park and will be redeveloped to include 250 homes and a 2 stream primary school scheduled to open in 2015.

3.2.5 South of the Cannon Rubber Site is the ‘High Road West’ development area. This location will contain 1,450 new homes. This location may also see either a phased replacement of the social housing stock belonging to Homes for Haringey or the connection of a significant proportion of the existing stock to the district heating scheme proposed in this study or both. For the purposes of this study it will be assumed that the following existing Homes for Haringey properties will be connected:

- Charles House
- Moselle House
- Ermine House

3.2.6 The new homes to be built on the two sites discussed above are assumed to be delivered over a 10 year period from 2015 to 2024.

3.2.7 In addition to the loads above the following buildings surrounding White Hart Lane were considered in the analysis:

- Haringey 6th Form College
- St Francis De Sales Infant and Junior School
- St Pauls and All Hallows Infant and Junior School
- Northumberland Park Community School
- Homes for Haringey Properties

- Charles House
- Moselle House
- Ermine House
- The Lindales
- Woodmead
- Trulock Court
- Concord House
- Coombes House

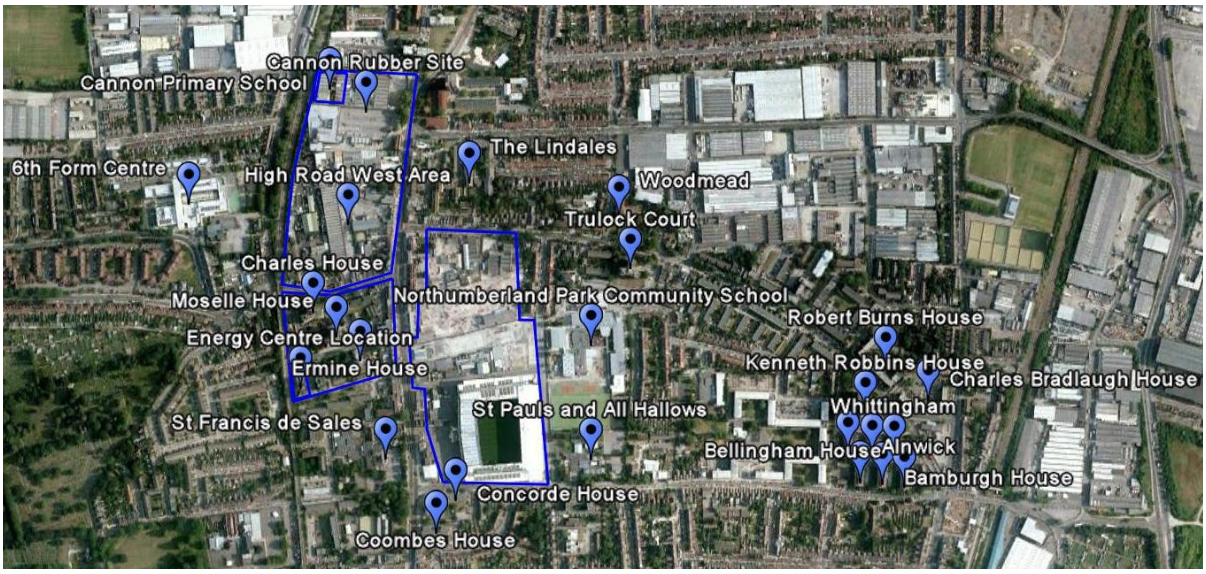
Each of the schools identified above was visited by PB to identify if it was practical to connect them to district heating and to make an initial assessment of how this would be achieved.

3.2.8 Finally to the west of White Hart Lane the following Homes for Haringey Properties were considered:

- Alnwick
- Bamburgh House
- Bellingham House
- Cheviot House
- Corbridge
- Whittingham
- Kenneth Robbins House
- Charles Bradlaugh House
- Robert Burns House

3.2.9 The following map illustrates the buildings and development areas considered for connection:

Figure 3-1 White Hart Lane Satellite Scheme



3.3 Information received

3.3.1 The desktop survey analysis was supported by mapping data made available by Haringey Council for the housing stock owned by Homes for Haringey.

3.3.2 The council's energy management department supplied the monthly gas consumption data for the majority of the public buildings identified. Where this data was not held by the council the information was sought from the contacts provided by the Council.

3.3.3 Gas consumption for Homes for Haringey properties identified is taken from Haringey Council's submission to the London heat map. Information on the Northumberland Park Development and Cannon Rubber site loads and connection dates was based on an updated energy statement memorandum released to PB by Buro Happold and DE for London.

3.4 Heat demand

3.4.1 Based on the buildings identified and energy data received, the annual heat demand for each building was developed and is presented in the tables below.

3.4.2 Where monthly gas consumption information was available the data was corrected for boiler efficiency and degree day corrected to 20 year average values. The degree day analysis was also used to calculated the split between variable (i.e. space heating) and baseload (i.e. hot water) demand.

3.4.3 Annual gas consumption data for the social housing stock was made available. This data was converted to heat and split between space heating and hot water.

3.4.4 Energy data for Northumberland Development Park and the High Road West Development are based on the data supplied. Table 3-2: Annual Heat Demand for Development Sites.

Table 3-1: Annual Heat Demand for Development Sites

Property		Construction Year	Annual Heating Demand (kWh)	Variable Space Heating Proportion	Baseload / Hot Water Proportion
Northumberland Development Park					
1 NDP North Block	**Supermarket**	2013	686,000	90%	10%
	Offices		429,000	85%	15%
	Education facilities		139,000	75%	25%
2 NDP Stadium	**Stadium**	2016	1,775,000	90%	10%
	Hotel		1,065,000	70%	30%
	Retail & restaurants		649,000	80%	20%
3 NDP South Block	**Residential units**	2019	1,281,000	60%	40%
	Health Club		1,300,000	70%	30%
	Health Centre		360,000		
	New Education		350,000		
Cannon Rubber Site					
Cannon Residential		2015	1,725,000	60%	40%
Cannon Primary School			135,000	76%	24%
High Road West					
High Road West Residential		2015-2019	10,475,000	60%	40%
High Road West Commercial		2015-2024	600,000	77%	23%

Table 3-2: Annual Heat Demand for Existing Identified Loads

Property	Year Available	Annual Heating Demand (kWh)	Variable Space Heating Proportion	Baseload / Hot Water Proportion
Haringey Schools				
6th Form	2015	1,038,084	72%	28%
St Francis De Sales		324,016	75%	25%
St Paul and All Hallows		216,000		
Northumberland Park Community School		1,361,143		
Homes for Haringey - Central Housing				
Charles House	2015	586,238	75%	25%
Moselle House		575,781		
Ermine House		591,930		
The Lindales		667,985		
Woodmead		325,046		
Trulock Court		573,947		
Concord House		218,704		
Coombes House		160,623		
Homes for Haringey - East Housing				
Alnwick	2015	114,865	75%	25%
Bamburgh House		115,056		
Bellingham House		110,566		
Cheviot House		116,109		
Corbridge		107,391		
Whittingham		101,532		
Kenneth Robbins House		741,615		
Charles Bradlaugh House		337,840		
Robert Burns House		479,578		

Table 3-3: Annual Heat Demand Load Summary

Property	Construction Year	Annual Heating Demand (kWh)	Variable Space Heating Proportion	Baseload / Hot Water Proportion
NDP Phase 1	2013	1,254,000	87%	13%
NDP Phase 2	2016	3,489,000	82%	18%
NDP Phase 3	2019	3,291,000	66%	34%
Cannon Rubber Site	2015	1,860,000	61%	39%
High Road West	2015-2024	11,075,000	61%	39%
Haringey Schools	2015	2,939,243	74%	26%
HfH Housing Central Total	2015	3,700,255	75%	25%
HfH Housing West Total	2015	2,224,552	75%	25%

3.5 Location of the energy centre

3.5.1 Haringey Council have identified a suitable location for an energy centre located at the corner of Love Lane and Whitehall Street approximately 100m west of the High Road. This location if ultimately selected would provide good access to all the development sites. The location of the energy centre is shown in the figure in the next section.

3.6 District heating routing

3.6.1 Starting from the location identified above for the energy centre a least cost route was identified. The route identified in the figure below prioritises a direct connection to the development sites. Within these sites the no network is shown as this is assumed to be within the gift of the plot developers.

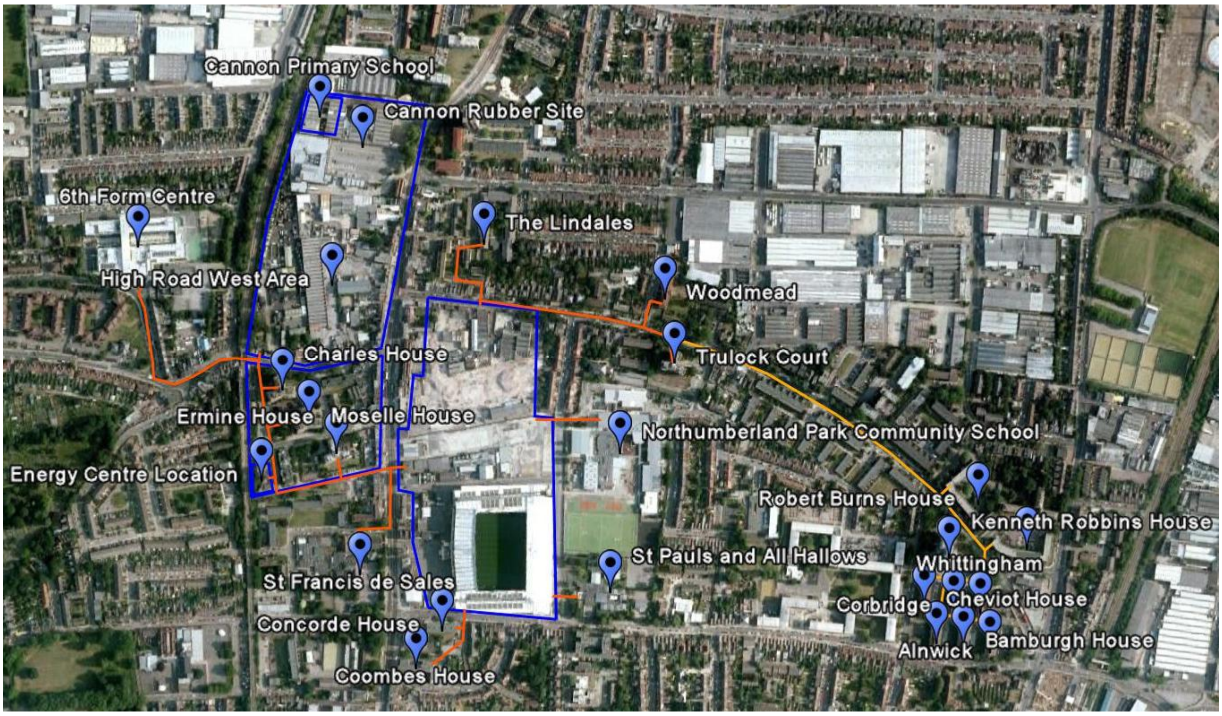
3.6.2 It is important that to enable further connections to be connected economically, that suitable onward connection points are made available by the developers of the sites at strategic points.

3.6.3 The network will cross the underground River Moselle as it crosses White Hart Lane to reach the High Road, Cannon Rubber and Haringey 6th Form sites.

3.6.4 The route minimises the length of pipework on the High Road. The only exceptions are the crossing of the road to Northumberland Park from the energy centre and a short stretch required to connect St Francis de Sales Infant and Junior school to the network.

3.6.5 The only rail crossing in the network is along the road under a railway bridge on White Hart Lane to serve Haringey Sixth form.

Figure 3-2: White Hart Lane Satellite Scheme



3.7 Connection viability test

3.7.1 After the load of each connection was ascertained and a network route identified, a high level connection assessment was conducted to determine the viability of connecting the loads which are not located within the development sites.

3.7.2 The high level test is based on the net revenue potential for each load discounted using HM Treasury social discount rate of 3.5% to pay back the incremental cost of connection which includes the cost of the district heating pipework, building conversion cost. The test includes a one off cost saving for social housing and public sector loads from no longer needed to replace a gas fired boiler.[10]

3.7.3 The tables below shows the connection cost and high level payback period for connecting each school and the Homes for Haringey central and east clusters. The cost is based on the incremental distance required for each connection or group of connections.

[10] Residential avoided cost £1,250, Non Residential avoided cost £35 per kW installed capacity.

Table 3-4: Connection Viability Assessment – Public Sector Loads

Property	Connection Cost	Payback Period (Years)
Development Sites[11]		
Northumberland Development Park[12]	£206,850	2
Cannon Rubber and High Road West	£167,450	2
Haringey Schools		
6th Form	£283,000	19
St Francis De Sales	£122,950	30
St Paul and All Hallows	£35,225	60
Northumberland Park Community School	£68,650	4
Homes for Haringey		
Central	£1,386,000	28
East	£1,428,300	n/a

3.7.4 The connections to the development sites have very short payback times because they do not include to cost of the site infrastructure required to support district heating; it is assumed this will be incurred by the developer.

3.7.5 The connection of the Haringey schools to the network is justifiable in all cases except for St Paul and All Hallows where even the relatively short connection shown in the figure above cannot be paid back based on the school's heat load. The school however will be included in the analysis as its detrimental impact on the economics of the scheme will be minimal.

3.7.6 The connection of the Homes for Haringey properties in the central area is justifiable. The payback of this cluster could be improved if required by removing some of the more distance properties in the central cluster.

3.7.7 The connection of the Homes for Haringey properties in eastern area is not justifiable. The payback period for the heat load served is too long. There are options which could be explored to improve the payback period one option would be if in addition to the assumed avoided cost incorporated in this analysis, the cost of conversion is funded from another source such that the revenue from the connection would only be required to fund the initial district heating link; this would likely need to be combined with another option which would be to secure additional heat loads along the route served.

[11] Does not include of the network inside the sites
[12] Based on all loads connected in 2019

3.8 Plant room interfaces

3.8.1 Each of the buildings for the proposed central scheme was visited to how the district heating could be routed to the boiler room and assesses the compatibility of the existing system with district heating.

3.8.2 For each building a description of the boiler room and location is available in appendix 6.3. In addition a detailed map showing the location of the boiler room and an indicative schematic showing where the district heating interface would connect into the existing system is shown in appendix 6.5.

3.9 Electrical connection

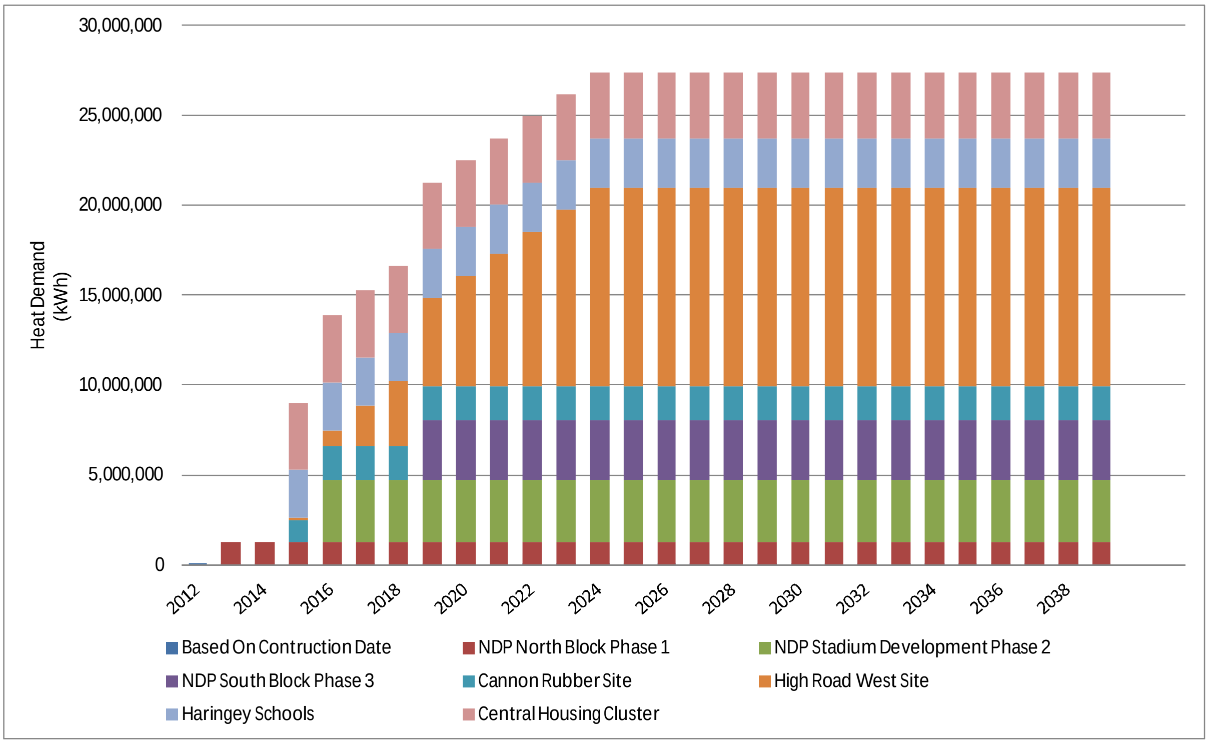
3.9.1 PB has held discussions with UK Power Networks, the local district network operator, on the suitability of the local electrical infrastructure to accept a connection from the proposed CHP unit.

3.9.2 UKPN has responded with an initial quotation of £150,000 to connect. However, as for the Tottenham Green scheme, PB would recommend that detail of this quote is further pursued at the next stage of analysis.

3.10 Load projection

3.10.1 Based on the loads identified as suitable for connect to the district heating network and the timeline presented in the previous sections in the figure below shows the load build up.

Figure 3-3: Heat Load Projection Based on Construction Data



3.11 Modelling methodology

3.11.1 PB's modelling methodology is outlined in section 2.11.

3.12 Options considered

3.12.1 PB has modelled three heat supply options:

- Private sector Energy Services Company Supply (from site-based energy centre) (base case)
- Public sector-led Energy Services Company Supply (from site-based energy centre)
- Connection to DEN (avoiding need for energy centre building)

3.12.2 The two ESCo options will be based on gas engine CHP with top-up and standby heat provided by gas boilers. The DEN option assumes it is able to provide an unlimited supply of heat.

3.12.3 To determine the CHP engine sizes to present in this study, PB used a simple rule of thumb as a starting point – that the engine acting as lead unit should serve the majority of the heating demand whilst achieving at least 5,000 to 5,500 annual operating hours.[13] Thermal storage was included in the two decentralised options to allow for increased utilisation of the CHP.

3.12.4 The table below presents the energy centre main plant items configurations for the for the three scheme scenarios modelled. Each scheme scenario will be presented with two CHP options.

Table 3-5: Energy Centre Main Plant Item Configuration

	Option A DEN	Option B CHP	Option C CHP
CHP (kWe)	n/a	2 x 1497	2 x 2002
CHP (kWth)	n/a	2 x 1622	2 x 1916
Thermal Store Size (m3)	n/a	125	150
Gas Boilers (kWth)14	n/a	24,000	24,000

3.12.5 The engines chosen for the CHP scenario are phased into service based on the heat load build up. The first engine comes on line with the scheme in 2015 and the second engine starts operation in 2019. Phasing the introduction of the engines allows the size to better match the load build up and delays the capital spending on the second engine by four years.

[13] This is based on 17 hour per day operation and a 92% industry standard availability profile.
[14] Sized for 2026 Loads

3.13 Capital cost estimates

3.13.1 The increased capital cost estimates each for each configuration described above is presented in the table below.

Table 3-6: Additional Capital Cost Spend for Connection of Public and HfH Loads

		Option A Base Case	Option B 2x1497kWe	Option C 2x2002kWe
CHPs		£0	£2,052,000	£2,400,000
Boilers			£2,040,000	£2,040,000
Thermal Store			£110,000	£126,000
EC Building			£750,000	£750,000
DH Network		£1,565,925	£1,565,925	£1,565,925
Non-Residential	**Conversion Cost**	£140,000	£140,000	£140,000
	Avoided Cost e.g. new boilers	(£132,300)	(£132,300)	(£132,300)
HfH Properties	**Conversion Cost**	£1,194,000	£1,194,000	£1,194,000
	Avoided Cost e.g. new boilers	(£497,500)	(£497,500)	(£497,500)
Total		£2,270,125	£7,222,125	£7,586,125

3.14 Maintenance and annual cost assumptions

3.14.1 No avoided maintenance and annual costs have been included in this analysis.

3.14.2 The following maintenance and annual cost assumptions have been made:

- Energy centre maintenance costs 1% of capital expenditure
- District heating network maintenance costs 1% of capital expenditure
- £500 per annum per non-residential connection for billing and invoicing.
- £150 per annum per non-residential connection for billing, invoicing and HIU maintenance.

Table 3-7: Maintenance Costs

	Option A Base Case	Option B 2x1497kWe	Option C 2x2002kWe
CHPs	£0	£174,884	£224,543
Invoicing, Billing and Maintenance	£329,700	£329,700	£329,700
Energy Centre	£0	£29,000	£29,160
DH Network	£15,659	£15,659	£15,659
Total	£345,359	£549,243	£599,062

3.15 Replacement cost assumptions

3.15.1 CHP engines typically have an operating life of approximately 80,000 hours. Based on annual operating hours modelled the engines shown would be replaced in year 15.

3.15.2 The energy centre gas boilers are assumed to be replaced in year 20.

3.15.3 All other major assets are assumed to have a life expectancy exceeding the whole life costing period of 25 years.

3.15.4 The base case assumes non-residential gas boilers are replaced every 15 year and residential gas boilers every 15 years.

3.16 Utility and heat prices

3.16.1 In order to ensure that there is a comparable basis between satellite schemes, a single set of utility price assumptions has been adopted in modelling of plant operation.

3.16.2 As for the Tottenham Green scheme, DECC forward price projections have been adopted in the modelling of the White Hart Lane scheme.

3.16.3 The table below outlines which data series is used for each energy stream in the modelling.

Table 3-8: Energy Stream Data Series

Energy Stream	Series Used	Adjustment Applied
Energy Centre Gas	Industrial	None
Energy Centre Electricity Export	Wholesale	
Energy Centre Electricity Import	Residential	
Commercial Price for Heat	Service Gas Price	1st Gas Boiler Efficiency 2nd 10% Discount for Public Buildings and Social Tenants 3rd p/kWh Standing Charge
Residential Price for Heat	Residential Gas Price	
DEN Heat Price	Data supplied from strategic network study	

3.16.4 As indicated in the table above the sale price of heat to end users is made up of three elements; a correction for gas boiler efficiency, a 10% discount on the resulting sale price (if applicable) and a p/kWh standing charge element.

3.16.5 The standing charge element ensures the consumer of the heat is contributing to maintenance of the network and administration of their account. This charge has been set at 0.25 p/kWh for commercial customers and 2 p/kWh for residential customers. At this level the charge as set will recover from consumers the ongoing maintenance of the energy centre and district heating network (excluding CHPs) and the cost of account maintenance.

3.16.6 The table provides an example for the year 2020 of the price make up for the four categories of consumers.

Table 3-9: Heat Sales Price Build Up for Existing and New Connections in 2020

	Commercial		Residential	
	Existing	New	Existing	New
Services Gas Price	3.65	3.65	5.08	5.08
Boiler Efficiency	80%	80%	83%	83%
Heat Price	4.56	4.56	6.13	6.13
Heat Sales Discount	10%	n/a	10%	n/a
Heat Price After Discount	4.11	n/a	5.51	n/a
Standing Charge Element	0.25	0.25	2.00	2.00
Heat Sales Price	4.36	4.81	7.51	8.13

3.17 Results

3.17.1 PB modelled the performance of the two CHP options against the base case of the proposed district energy network. The performance of the CHP units modelled is shown in the table below.

Table 3-10: Central Scheme CHP Results

	Option B 2x1497kWe	Option C 2x2002kWe
2016		
CHP Operating Hours	4,893	4,680
CHP Heat	52%	58%
Boiler Heat	48%	42%
2020		
CHP Operating Hours	5,369	5,295
CHP Heat	62%	69%
Boiler Heat	38%	31%
2024		
CHP Operating Hours	5,399	5,374
CHP Heat	54%	61%
Boiler Heat	46%	39%

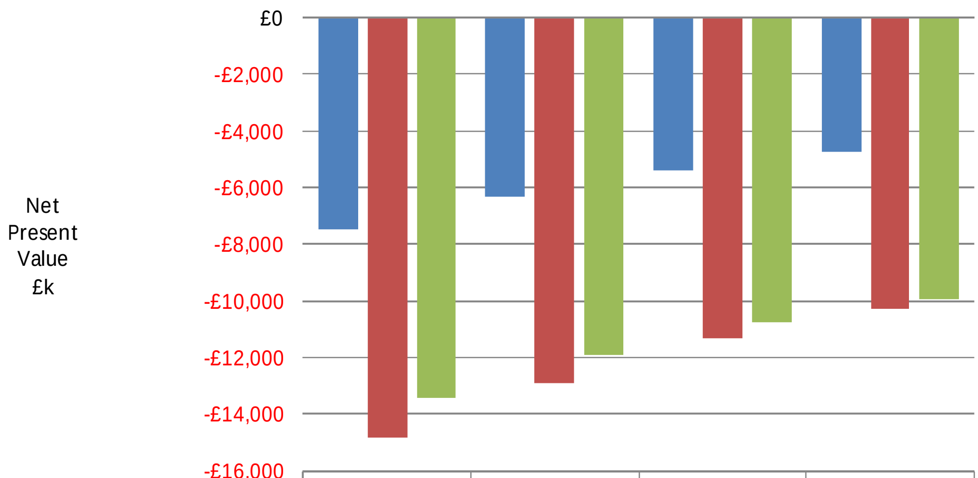
3.17.2 The economic results are presented for a range of discount rates. In all cases, the DECC central utility price scenario was used (see Section 2.14).

3.17.3 Results are presented for both the cost of heat generation, i.e. without the inclusion of heat sales in the district heating options, and for commercial performance, i.e. including heat sales in the district heating options.

3.17.4 The table and figure below shows the difference between the cost of heat generation for CHP options compared to the DEN supply case at a range of discount rates.

3.17.5 This graph shows how the CHP options cost more to operate than the DEN supply options at all discount rates over the 25 year project lifetime. These figures are based around a calculated heat generation cost from the wider DEN system (excluding cost of capital repayment of the DEN).

Figure 3-4: Central and West Scheme – Comparison of the Cost of Heat Generation

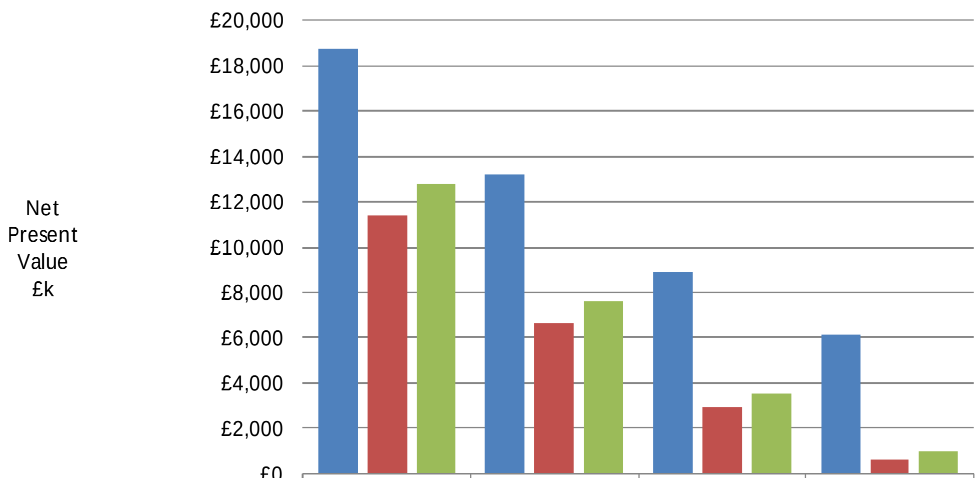


	3.5%	6.0%	9.0%	12.0%
Option A - DEN Heat Supply	-£7,471	-£6,326	-£5,392	-£4,754
Option B - 2 x 1497 kWe CHP	-£14,842	-£12,900	-£11,339	-£10,293
Option C - 2 x 2002 kWe CHP	-£13,415	-£11,947	-£10,746	-£9,926

3.17.6 The figure below shows the commercial performance of the two district heating options modelled over the 25 year project lifetime, i.e. including heat sales.

3.17.7 This graph shows how a district heating network supplied by either a District Energy Network or a CHP based energy centre can generate a positive net present value even at a high discount rate required by a private sector ESCo.

Figure 3-5: Central and West Scheme – Net Present Value Performance of District Heating Options Modelled.



	3.5%	6.0%	9.0%	12.0%
Option A - DEN Heat Supply	£18,722	£13,202	£8,900	£6,119
Option B - 2 x 1497 kWe CHP	£11,351	£6,629	£2,953	£580
Option C - 2 x 2002 kWe CHP	£12,777	£7,582	£3,546	£947

3.17.8 These results show how, based on the heat demand developed and the options modelled, there is a clear case for the use of heat derived from the DEN.

3.18 Emissions analysis

3.18.1 Emissions projections for the CHP schemes analysed have been calculated on the basis of the emissions factors contained within the current Building Regulations approved documents[15]. These are:

Table 3-11 Emissions Factors

Fuel type	Emissions factor ($kgCO_2$ / kWh)
Mains gas	0.198
Heating oil	0.274
Electricity (import)	0.517
Electricity (export)	0.529

3.18.2 The projected emissions savings are shown against individual gas boilers for reference only. The carbon savings achieved by the overall DEN are reported in the ULV DEN report.

	Individual Gas Boilers	Option B 2x1497kWe	Option C 2x2002kWe
Emissions tCO_2	6,780	3,419	2,343
Emission Saving		3,360	4,436
		50%	65%

[15] Building Regulations Part L2A references the emissions factors with SAP2009, table 12, http://www.bre.co.uk/sap2009/page.jsp?id=1642, accessed January 2012.

3.19 Risks

3.19.1 The following table represents a shortlist of key risks and uncertainties that PBES is currently aware of for the project.

Table 3-12 Key project risks

No.	Risk name	Possible Consequences	Mitigation Action	Score (high, medium, low risk)
1	Timing of DEN emergence means that alternative solutions for WHL energy supply must be adopted initially	Reduces potential contribution towards DEN installation from developers	Carefully programme management of DEN and WHL installation to ensure that both projects can be delivered with minimal programme risk	H
2	Scheme is not regarded as sufficiently viable for ESCo partner (DEN option)	ESCo partner cannot raise funds to proceed with scheme.	Adopt a public-sector lead governance structure with access to low-cost finance. Review opportunities for cost savings and / or other potential heat loads.	M
3	Energy centre locations identified are not suitable	No suitable location for energy centre in local area means the likelihood of setting up a viable scheme is reduced.	Review local area for other suitable locations if ones identified are not suitable. If necessary reserve are	M
4	Developers averse to providing suitable connection points to connect properties to the north, east and south of the NDP development.	It may not be economic to connect these properties if the aforementioned connection is not available.	Review practicality of making the availability of suitable connection points to extend the district heating network mandatory.	M

4 HALE VILLAGE

4.1.1 Hale Village is a large, mixed use, high-density development close to Tottenham Hale railway station. This development is operational, and the final phases are currently under construction. The site at full build-out will include student accommodation (approx 1,200 units), 542 affordable housing units, 486 private residential units, a 130-room hotel, a school (tbc) and commercial space (approx 45,000 sq ft).

4.1.2 The development energy centre currently contains 2 no. 1.6MWth biomass pellet boilers, gas top-up boilers, and thermal storage. There are plans to introduce a gas-fired CHP unit to the energy centre.

Figure 4-1 Hale Village Energy Centre Location Illustration

4.1.3 The scheme currently benefits from RHI support, and the operator of the energy centre (Dalkia) is in a 25-year heat supply concession agreement for the site.

4.1.4 During their contract period, Dalkia would only be interested in connection if the heat supplied from the DEN would be at a price and carbon content lower than their current heat generation costs. This is unlikely to be achievable for the DEN during the period during which Dalkia receive RHI support and hence two potential dates of intervention / connection are suggested likely for Hale Village. The date when RHI support ends (i.e. 2030) or the date at which the supply agreement ends (i.e. 2035). The current model for scheme expansion assumes the earlier of these potential connection dates.

5 OVERALL SATELLITE SCHEME CONCLUSIONS

5.1.1 Tottenham Green

A scheme based around the existing loads at Tottenham Green only is not viable. The price for heat which can be charged to the commercial users to be competitive with their current price for gas does not generate sufficient net revenue to cover the capital costs of both the network required, the energy centre to house the key plant, and the customer connections.

It is not viable to connect the Homes for Haringey properties in the east of the study area (i.e. those toward Hale Village). If additional local load and / or conversion funds can be found from alternative sources then it may be worth reviewing this option. Similarly, if it can be demonstrated at the end of the energy supply concession in Hale Village that heat supply from the DEN is a realistic proposition for Hale Village, then the connection to the Homes for Haringey properties to the east of the Tottenham Green should be re-evaluated.

The viability of a decentralised energy scheme at Tottenham Green rests on securing the Lawrence Road and Turner Avenue loads with a developer contribution from both developments.

Capturing additional value of 1.5 p/kWh from exported electricity can make the Tottenham Central and West scheme commercially viable at 12% rate of return. In all other scenarios the scheme's level of whole life cost performance indicates that it is only likely to be viable with public sector support and access to low cost finance. It is therefore recommended that the public sector takes this scheme forward to 'pump-prime' and de-risk the project's implementation.

Connection to Tottenham Green from the DEN leg to White Hart Lane at the point in time of initial DEN installation is not recommended, both as the level of income projected from the scheme would not recoup the expense of the connection (including the avoided energy centre cost), and also as the addition of this length of network would add significant financial risk to the DEN project with only marginal prospective reward. Hence, connection of the Tottenham Green scheme to the DEN is proposed at the point in time when the CHP engine initially installed becomes life-expired. This will allow the DEN connection to benefit from the avoided cost of CHP replacement. However, this cost saving alone will not be equivalent to the cost of linking the DEN network at White Hart Lane to the Tottenham Green scheme, and hence additional connections, including Broadwater Farm, other Homes for Haringey loads on the High Street, and other High Street Retail properties will be required to improve the economic performance of this link.

5.1.1 White Hart Lane

The analysis of this study corroborates the preliminary conclusions drawn in the ULV DEN report. The evidence of this work supports the broad strategic approach recommended for the DEN expansion to White Hart Lane in its initial phase, with a view to connection of the loads along the Tottenham High Road and Tottenham Green in later phases of scheme expansion.

The analysis here shows that the sale of heat from the DEN system to the development of Northumberland Park offers significant opportunity for the scheme to contribute to the overall cost of the DEN installation, whilst maintaining the same heat sales price as would be seen under a private-sector ESCo method of heat provision.

The scale of heat supply in the area around Northumberland Park Development is recommended to include the Cannon Rubber and High Road West development areas and in addition provide a social benefit from the supply of nearby schools and social housing properties.

A key aspect of both areas of development will be the programme management of connections and generating confidence in the emergence of the DEN heat supply system, or the district heating system around Tottenham Green.

5.1.2 Hale Village

The supply of heat to Hale Village from the DEN is a long-term prospect only, as it is considered unlikely that the current incumbent heat provider, Dalkia, will have short-term commercial interest in taking a heat supply from the DEN. Dalkia currently operate two biomass boilers (with RHI support) and will shortly be operating a small CHP unit to generate low-carbon heat for distribution around the Hale Village site. Technically, the installation is well suited to connection to the DEN, but the only potential avoided cost for Dalkia during their concession-agreement period is the cost of replacement of their primary plant. The comparative cost of connection of the Hale Village area to the planned DEN at White Hart Lane would be significantly higher than the avoided plant replacement costs. With little (if any) operating cost margin anticipated from connection to the DEN, there is no commercial case for this connection currently. This situation will change when the level of RHI support for the biomass installation reduces (around 2029), and further when the concession period ends around 2034.

5.2 Recommendations

5.2.1 Tottenham Green and White Hart Lane

- Engage with developers early to plan for the installation of district heating pipework in the ground and to incorporate it into building design (particularly in terms of mechanical secondary system design to give low return temperatures). This will require dialogue with the M&E designers of the proposed development. PB would stress the importance of this.

- If and when approval for district heating is given start to build this into existing plant maintenance and replacement schedules.

- Temporary boiler plant will be required for properties completed and occupied before the availability of district heating. Review how this will be handled from a planning perspective in conjuction with the GLA anddealt with in terms of development contributions.

- The connection of Homes for Haringey properties located to the east of both schemes was deemed not viable. However a periodic review should be undertaken to identify other properties which could be encouraged to connect either now or in the future.

5.2.2 Tottenham Green

- Turner Avenue is key to enabling the viability of the Lawrence Road connection and that of the Tottenham Green scheme. Review if, when and how the redevelopment of this area will be achieved, and ensure that any energy strategy developed is fully compatible with the use of decentralised energy.

5.2.3 White Hart Lane

- The White Hart Lane development should connect to the wider DEN as soon at it becomes available. This will enable a low-carbon source of heat to be used at a cost comparable to other heat supply routes. At the same time, the use of heat from this source will enable further customers to benefit from the low carbon supply infrastructure, and contribute towards developing low-carbon heat supply infrastructure for London. This will generate potential to reduce fuel poverty and carbon emissions in other areas of Haringey, Enfield, and Waltham Forest.

- In the interim period until the DEN supply is available, provision for heat supply from gas-boilers should be made. This should be time-limited such that if, for whatever reason, the DEN does not materialise, that low carbon plant such as CHP must then be installed locally to deliver carbon savings to the development.

- Space provision for an energy centre to house CHP plant and top-up boilers for centralised supply should be allocated to cater for the non-DEN scenario.

- Under all scenarios of heat provision, it is recommended that a public sector SPV takes governance of the heat supply to White Hart Lane. This SPV should be linked to the DEN delivery vehicle, such that the overall DEN system can function coherently under a single management / financial structure.

5.2.4 Hale Village

- Contact should be maintained with Dalkia and the Hale Village site management, in order to be able to assess at a later phase the potential opportunity for extension of the DEN to the Hale Village area.

6 APPENDICES

6.1 Tottenham Green – Plant Room Descriptions

6.1.1 Each of the buildings for the proposed central scheme was visited to how the district heating could be routed to the boiler room and assesses the compatibility of the existing system with district heating.

6.1.2 For each building a description of the boiler room and location is shown below. In addition a detailed map showing the location of the boiler room and an indicative schematic showing where the district heating interface would connect into the existing system referenced in the text below is available in appendix 6.4.

6.1.3 Tottenham Green Leisure Centre

The boiler room is located in the north west corner of the building. Access for the district heating would be via Philip Lane.

The boiler room has 4-off Remeha Gas 460 Boilers which appear to be relatively new and in good condition. The boiler room is a steel mezzanine floor at ground level and above the basement which runs under the pools with extensive filter plant etc. There is another steel floor above the boiler level with the air handling unit (AHU) plant. There are 4 gas fired DHW heaters (AO Smith model ADM90G) positioned alongside the main boilers. The LPHW heating and pool circulation pumps are situated on the basement floor. The pumps are Armstrong D160 pumps.

This location has ample space on the basement floor for district heating plate heat exchanger whilst on the boiler floor space is more limited and it is likely one of the existing boilers would need to come out.

Schematic M006, Location drawing M017

6.1.4 The Bernie Grant Centre

The boiler room is located in basement of the north east corner of the main building behind. Access for the district heating would be from Town Hall Approach Road between the arts centre and Conel.

6.1.5 The boiler room looks fairly new. There are two Wessex Modumax boilers. There is a lot of air handling unit plant and drinking water plant also present. Space is available for the heat exchanger package inside and also in an outside area which has open flooring above at ground level. The buildings are of modern construction and are 3 storeys. Total plan area of the two buildings is 1500 sqm approx.

Schematic M014, Location drawing M018

6.1.6 Tottenham Town Hall

The Town Hall Building boiler room is located in the basement in the south east corner of the building. Access for the district heating would be from Town Hall Approach Road between the building and Conel.

The boiler room has two Strebel RU1S-6 gas boilers dated 1990. They are rated 320kW, 4 bar at 110 degrees C. Model number 90/02/RU1S-6/47807. There is also 1-

off AO Smith gas fired DHW heater. There is space in front of the boilers for a district heating plate heat exchanger.

Schematic M007, Location drawing M018

6.1.7 College of North London (Conel)

The college in Tottenham is split across two sites, the one between the Tottenham Green Centre and the Bernie Grant Arts Centre is composed of a single building and the second comprising several buildings is south of the Tottenham Town Hall Building.

The boiler room of the first single building site is located in the south east corner. Access is available from Town Hall Approach Road.

The boiler room contains two Strebel boilers which appear to be approaching the end of their useful life and one AO Smith water heater.

Access is from the side road off the main road. The gas inlet is located next to the boiler house old fuel store.

Schematic M013, Location drawing M018

The southern site has four plant rooms referred to here as Centenary, Tower, Block and Main. The plant rooms would be supplied by district heating from Town Hall Approach Road however routing within the site would require further on site review.

Conel - Centenary

The Centenary boiler room is a small ground floor plant room with 6 Wessex 50 Boilers (6-off) which appear to be quite old. There is a just enough space for a heat exchanger without removing a boiler. At present it is uncertain how the district heating pipework access the boiler room. This will require further review.

Schematic M012

Location drawing M018

Conel - Tower

The Tower boiler room is located on the 7th floor roof of the building and is in good condition with 2-Strebel boilers which look relatively new. Connection of this building to district heating would need to be reviewed to adopt the most practicable approach to overcoming the increased pressure requirements to reach the 7th floor. One approach will be to install a heat exchanger with a pump package.

Schematic M011, Location drawing M018

Conel - Main

The Main boiler room contains multiple boilers of different sizes. The building it serves is 4 storeys high with high windows. There is sufficient space to locate a heat exchanger.

Schematic M009, Location drawing M018

Conel - Block

The Block boiler house feeds the furthest block to the back of the complex. It has two Strebel boilers in good condition and appear to be relatively new. There is space for a heat exchanger package.

Access would be via the emergency doors to side of building.

Schematic M009, Location drawing M018

6.2 White Hart Lane – Plant Room Description

6.2.1 Each of the public buildings for the proposed scheme was visited to how the district heating could be routed to the boiler room and assesses the compatibility of the existing system with district heating.

6.2.2 For each building a description of the boiler room and location is shown below. In addition a detailed map showing the location of the boiler room and an indicative schematic showing where the district heating interface would connect into the existing system referenced in the text below is available in appendix 6.5.

6.2.3 St Francis de Sales RC Junior School

The school has a very small boiler room with little space for additional plant. There are 2-off Wessex 220M gas boilers which appear to be approaching the end of their useful life. One boiler would need to be removed to fit a new heat exchanger although there is already a heat exchanger; it is assumed this is to lower the temperature of the radiators suitably for the safety of the children. There is also an electric domestic hot water (DHW) boiler. Access to the plant room would via Brereton Road.

The approximate plan area of the building is 3000sqm.

Schematic M005, Location drawing M019

6.2.4 St Pauls and All Hallows School

This school is a ingle Storey Building with small ground floor plant room with two Potterton Derwent Compact boilers and one Andrews domestic hot water heater 370 litre capacity,80 kW heat input. Access would be via Academia Road.

The approximate plan area of the building is 1800sqm.

Schematic M016, Location drawing M022

6.2.5 Northumberland Park School

The boiler room is located on ground floor of 2 storey building. The building is of modern design and is approximately 1100 sqm plan area. There are two gas fired Strebel boilers and three gas fired water heaters for domestic hot water services. Access would be from Trulock road. The plantroom is in good condition and the boilers appear to be relatively new. There is not a lot of space for a heat exchanger package necessitating the removal of one of the boilers.

Schematic M008, Location drawing M020

6.2.6 6th Form College

Modern Plant room with 3 Hoval Ultra gas boilers that look fairly new and there is space for a heat exchanger. Access would be via Academia Road. The building has recently been rebuilt/refurbished and in two storeys high with a plan area of 6450 sqm.

Schematic M015, Location drawing M021

6.3 Appendix A – DECC price projections and model

6.3.1 Central Scenario

Real Energy Prices[3]: 2000-2030 **DECC Updated Energy & Emissions Projections - October 2011**

2010 prices

SCENARIO ASSUMPTIONS	
PRICES	Central
POLICY	Currrent
GROWTH	Central

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity[1]	p/KWh	4.81	7.03	7.32	7.82	7.64	7.64	7.68	7.67	7.39	7.41	7.59	7.99	8.17	8.22	8.73	9.01	9.06	9.37	9.50	9.59	9.86
	Gas	p/therm	42.7	61.2	67.0	71.8	77.7	78.6	78.6	73.8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
	Crude Oil ($/bbl)	$/bbl	81.0	108.6	109.6	110.6	111.5	112.5	113.5	114.5	115.5	116.6	117.6	118.6	119.7	120.7	121.8	122.9	124.0	125.1	126.2	127.3	128.4
	Coal	£/tonne	59.4	83.1	83.1	83.1	81.1	79.2	77.3	76.0	74.1	72.2	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3
RETAIL PRICES[2]																							
Electricity	Residential	p/KWh	12.9	14.4	15.4	16.2	16.7	16.9	17.5	17.8	17.5	18.0	18.7	19.3	19.6	19.6	20.1	20.6	20.8	21.2	21.3	21.2	21.5
	Services	p/KWh	7.7	12.1	12.7	13.6	13.7	13.7	13.9	14.1	14.0	14.3	14.8	15.4	15.6	15.7	16.2	16.6	16.7	17.1	17.1	17.1	17.3
	Industrial	p/KWh	6.8	11.5	12.1	13.0	13.2	13.1	13.4	13.5	13.4	13.7	14.2	14.8	15.0	15.1	15.7	16.1	16.2	16.6	16.6	16.6	16.9
Gas	Residential	p/KWh	4.2	4.3	4.6	4.8	5.2	5.3	5.4	5.3	5.0	5.0	5.1	5.1	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.3	5.3
	Services	p/KWh	2.3	3.2	3.4	3.6	3.9	3.9	4.0	3.8	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.8	3.8	3.8	3.8	3.9	3.9
	Industrial	p/KWh	1.9	2.7	2.9	3.1	3.4	3.4	3.4	3.3	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.4
Petroleum	Premium unleaded	p/litre	116.9	132.3	132.8	134.9	135.9	136.3	136.8	137.3	137.8	138.3	138.8	139.3	139.9	140.4	140.9	141.4	142.0	142.5	143.1	143.6	144.2
	Super unleaded	p/litre	123.8	139.7	138.9	140.8	143.2	143.7	144.2	144.7	145.2	145.7	146.2	146.8	147.3	147.8	148.3	148.9	149.4	149.9	150.5	151.0	151.6
	DERV	p/litre	119.3	140.2	140.8	142.9	143.9	144.5	145.0	145.6	146.2	146.7	147.3	147.9	148.5	149.1	149.7	150.3	150.9	151.5	152.2	152.8	153.4
	Average[4]	**p/KWh**	**8.1**	**9.3**	**9.3**	**9.5**	**9.6**	**9.6**	**9.6**	**9.6**	**9.7**	**9.7**	**9.7**	**9.8**	**9.8**	**9.9**	**9.9**	**9.9**	**10.0**	**10.0**	**10.0**	**10.1**	**10.1**

1 Electricity prices based on stated wholesale fossil fuel prices and central growth projection. Projected carbon price is fossil fuel price consistent.
2 Retail price projections are based on projected taxes, duties and policy cost recovery and averaged historical non-fuel markups.
3 Historical data are adjusted to 2010 prices using the the GDP Deflator series (YBGB)
4 Weighted average for private vehicles, weights reflect the fuel use mix in each year.

6.3.2 Low Scenario

Real Energy Prices[3]: 2000-2030 **DECC Updated Energy & Emissions Projections - October 2011**

2010 prices

SCENARIO ASSUMPTIONS	
PRICES	Low
POLICY	Currrent
GROWTH	Central

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity[1]	p/KWh	4.81	6.37	5.46	5.23	5.35	5.28	5.02	5.15	5.00	5.27	5.75	6.03	6.34	6.11	6.74	7.10	7.31	7.37	7.53	7.55	7.78
	Gas	p/therm	42.7	61.2	46.6	31.1	32.0	32.0	32.0	33.0	33.0	34.0	35.0	35.9	36.9	37.9	38.8	39.8	40.8	41.7	42.7	42.7	43.7
	Crude Oil ($/bbl)	$/bbl	81.0	108.6	106.5	104.4	102.3	100.2	98.2	96.3	94.3	92.5	90.6	88.8	87.0	85.3	83.6	81.9	80.3	78.7	77.1	75.6	74.1
	Coal	£/tonne	59.4	83.1	79.2	74.7	71.6	67.7	64.5	61.3	58.1	54.3	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1
RETAIL PRICES[2]																							
Electricity	Residential	p/KWh	12.9	13.7	13.1	12.8	13.5	13.4	13.5	14.0	13.7	14.3	15.1	15.5	16.0	15.7	16.5	17.0	17.4	17.5	17.8	17.6	17.7
	Services	p/KWh	7.7	11.4	10.7	10.8	11.1	10.8	10.6	10.9	10.8	11.1	11.7	12.0	12.4	12.2	12.9	13.3	13.6	13.6	13.7	13.7	13.8
	Industrial	p/KWh	6.8	10.9	10.3	10.4	10.9	10.8	10.7	11.0	11.1	11.6	12.4	12.9	13.2	13.0	13.7	14.2	14.4	14.6	14.6	14.6	14.8
Gas	Residential	p/KWh	4.2	4.3	3.7	3.0	3.1	3.2	3.3	3.4	3.4	3.5	3.6	3.6	3.7	3.8	3.8	3.9	3.9	4.0	4.1	4.1	4.2
	Services	p/KWh	2.3	3.2	2.6	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0
	Industrial	p/KWh	1.9	2.7	2.2	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5
Petroleum	Premium unleaded	p/litre	116.9	132.3	131.3	131.8	131.3	130.3	129.3	128.3	127.4	126.4	125.5	124.6	123.7	122.9	122.0	121.2	120.4	119.6	118.8	118.1	117.3
	Super unleaded	p/litre	123.8	139.7	137.3	137.7	138.6	137.6	136.6	135.7	134.7	133.8	132.9	132.0	131.1	130.2	129.4	128.6	127.7	127.0	126.2	125.4	124.7
	DERV	p/litre	119.3	140.2	139.0	139.4	138.7	137.5	136.4	135.3	134.2	133.2	132.1	131.1	130.1	129.1	128.2	127.2	126.3	125.4	124.5	123.6	122.8
	Average[4]	**p/KWh**	**8.1**	**9.3**	**9.2**	**9.3**	**9.2**	**9.1**	**9.1**	**9.0**	**8.9**	**8.8**	**8.8**	**8.7**	**8.6**	**8.6**	**8.5**	**8.5**	**8.4**	**8.3**	**8.3**	**8.2**	**8.2**

1 Electricity prices based on stated wholesale fossil fuel prices and central growth projection. Projected carbon price is fossil fuel price consistent.
2 Retail price projections are based on projected taxes, duties and policy cost recovery and averaged historical non-fuel markups.
3 Historical data are adjusted to 2010 prices using the the GDP Deflator series (YBGB)
4 Weighted average for private vehicles, weights reflect the fuel use mix in each year.

6.3.3 High Scenario

Real Energy Prices[3]: 2000-2030 **DECC Updated Energy & Emissions Projections - October 2011**

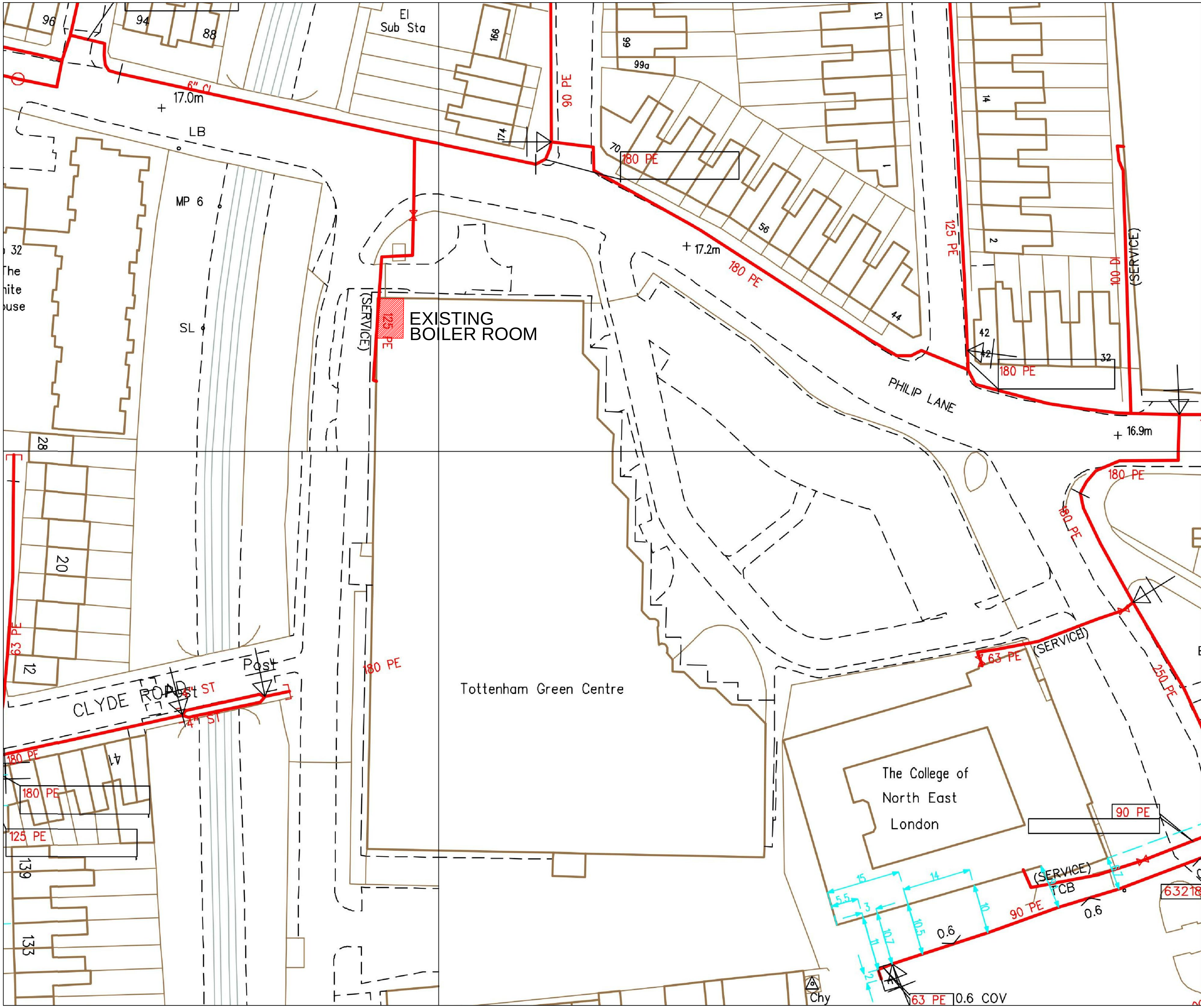
2010 prices

SCENARIO ASSUMPTIONS	
PRICES	High
POLICY	Current
GROWTH	Central

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity[1]	p/KWh	4.81	7.05	7.91	8.40	8.18	7.99	7.97	8.38	8.38	8.76	8.90	9.19	9.34	9.46	9.95	10.20	10.19	10.42	10.52	10.63	10.88
	Gas	p/therm	42.7	61.2	76.7	78.6	80.6	82.5	84.5	86.4	88.3	90.3	92.2	94.2	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1
	Crude Oil ($/bbl)	$/bbl	81.0	108.6	111.2	113.7	116.4	119.1	121.8	124.7	127.5	130.5	133.5	136.6	139.8	143.0	146.3	149.7	153.2	156.8	160.4	164.1	167.9
	Coal	£/tonne	59.4	83.1	87.5	91.4	92.0	93.3	93.9	94.6	95.2	96.5	97.1	97.7	97.7	98.4	98.4	99.0	99.0	99.0	99.0	99.0	99.0
RETAIL PRICES[2]																							
Electricity	Residential	p/KWh	12.9	14.4	16.0	16.8	17.3	17.3	17.8	18.5	18.5	19.5	20.1	20.6	20.8	20.9	21.4	21.8	22.0	22.3	22.4	22.3	22.6
	Services	p/KWh	7.7	12.1	13.3	14.1	14.3	14.0	14.2	14.8	15.0	15.6	16.1	16.6	16.8	16.9	17.5	17.8	17.8	18.1	18.1	18.1	18.3
	Industrial	p/KWh	6.8	11.6	12.7	13.6	13.7	13.5	13.7	14.2	14.4	15.1	15.5	16.0	16.2	16.4	16.9	17.3	17.3	17.6	17.6	17.7	17.9
Gas	Residential	p/KWh	4.2	4.3	5.1	5.1	5.3	5.5	5.7	5.8	5.9	6.1	6.2	6.3	6.5	6.5	6.5	6.5	6.5	6.5	6.6	6.6	6.6
	Services	p/KWh	2.3	3.2	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.8	4.9	4.9	4.9	4.9	5.0	5.0	5.0
	Industrial	p/KWh	1.9	2.7	3.2	3.3	3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.0	4.2	4.2	4.2	4.2	4.3	4.3	4.3	4.3	4.4
Petroleum	Premium unleaded	p/litre	116.9	132.3	133.6	136.5	138.2	139.6	140.9	142.3	143.8	145.2	146.7	148.2	149.8	151.4	153.0	154.7	156.4	158.2	160.0	161.8	163.7
	Super unleaded	p/litre	123.8	139.7	139.6	142.4	145.6	147.0	148.3	149.7	151.2	152.6	154.1	155.7	157.2	158.8	160.5	162.2	163.9	165.7	167.5	169.3	171.2
	DERV	p/litre	119.3	140.2	141.7	144.7	146.6	148.2	149.7	151.3	152.9	154.6	156.3	158.1	159.8	161.7	163.5	165.5	167.4	169.4	171.5	173.6	175.7
	Average[4]	**p/KWh**	**8.1**	**9.3**	**9.4**	**9.6**	**9.7**	**9.8**	**9.9**	**10.0**	**10.1**	**10.2**	**10.3**	**10.4**	**10.5**	**10.7**	**10.8**	**10.9**	**11.0**	**11.1**	**11.3**	**11.4**	**11.5**

1 Electricity prices based on stated wholesale fossil fuel prices and central growth projection. Projected carbon price is fossil fuel price consistent.
2 Retail price projections are based on projected taxes, duties and policy cost recovery and averaged historical non-fuel markups.
3 Historical data are adjusted to 2010 prices using the the GDP Deflator series (YBGB)
4 Weighted average for private vehicles, weights reflect the fuel use mix in each year.

Tottenham Green – Location and Plant Room Schematics



A	ISSUED FOR COMMENT	RK	RB	RB	
REV.	DETAILS	DRN	CHK	APPR	DATE

PARSONS BRINCKERHOFF

Energy Solutions - Infrastructure

6 Devonshire Square, London EC2M 4YE, UK
Tel: 44-(0)20-7337-1700 Fax: 44-(0)20-7337-1701

- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  LOCATION OF BOILER ROOM AT TOTTENHAM GREEN LEISURE CENTRE

DATE	02/0/12	DRAWN BY	RAYK
SCALE	1/750@A3	PRODUCED BY	
CAD REF		CHECKED	RB
		APPROVED	RB

- DRAWING NUMBER
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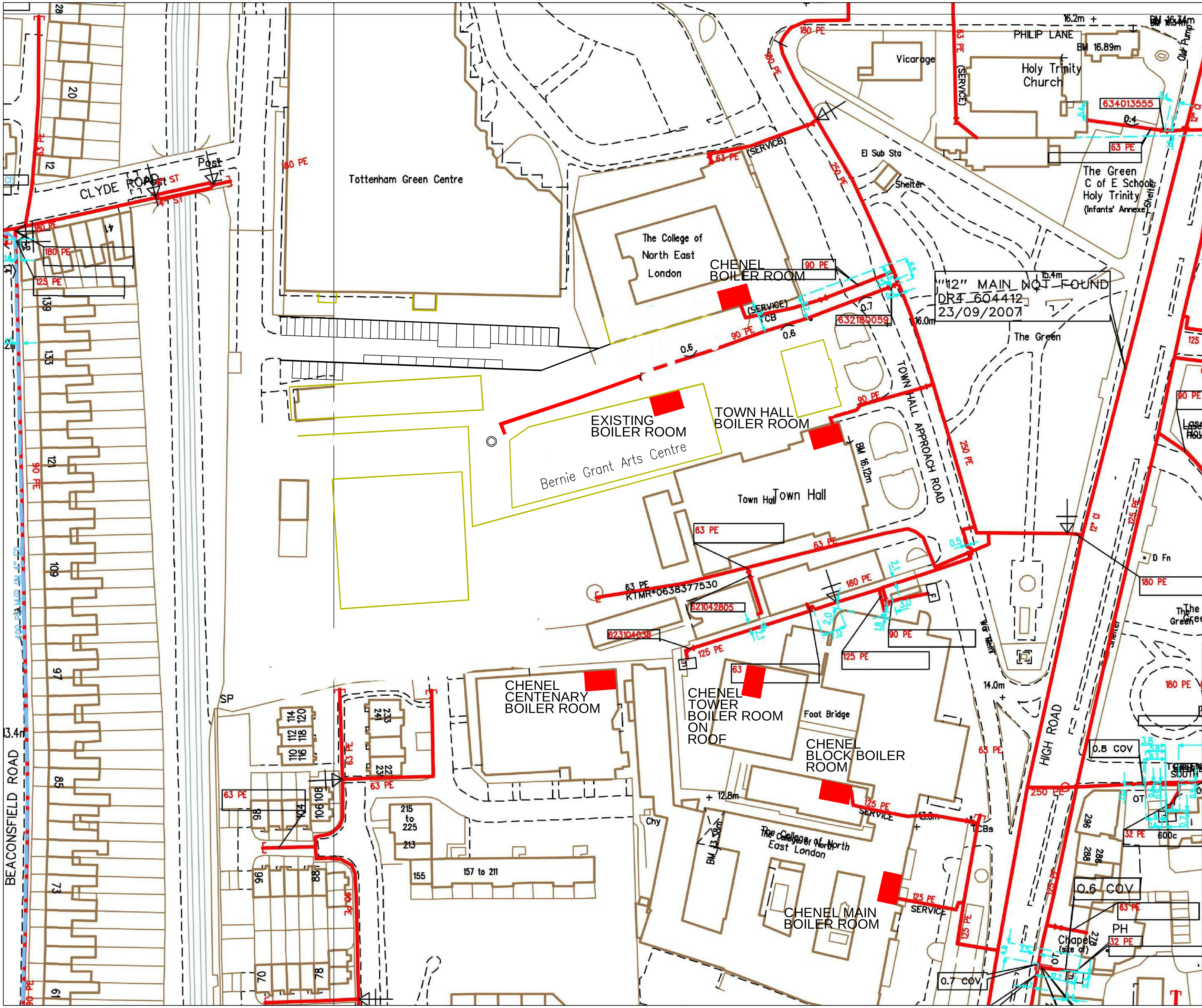

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

PARSONS BRINCKERHOFF

Energy Solutions - Infrastructure

6 Devonshire Square, London EC2M 4YE, UK
Tel: 44-(0)20-7337-1700 Fax: 44-(0)20-7337-1701

- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  EXISTING BOILER ROOM LOCATIONS FOR THE BERNIE GRANT CENTRE, TOWN HALL AND COLLEGE

DATE	23/03/12	DRAWN BY	RAYK
SCALE	1/750@A3	PRODUCED BY	
CAD REF		CHECKED	RB
		APPROVED	RB

- DRAWING NUMBER
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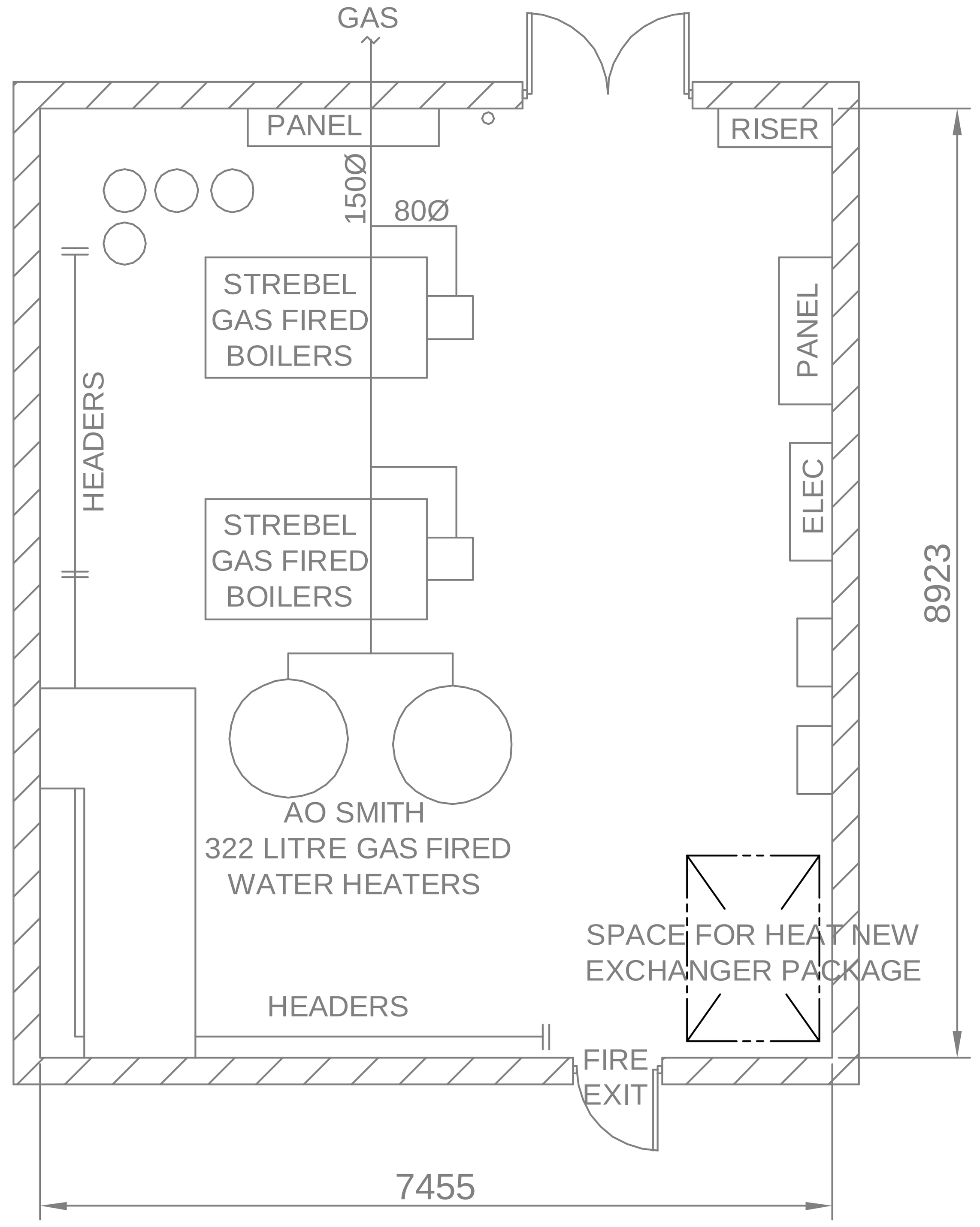
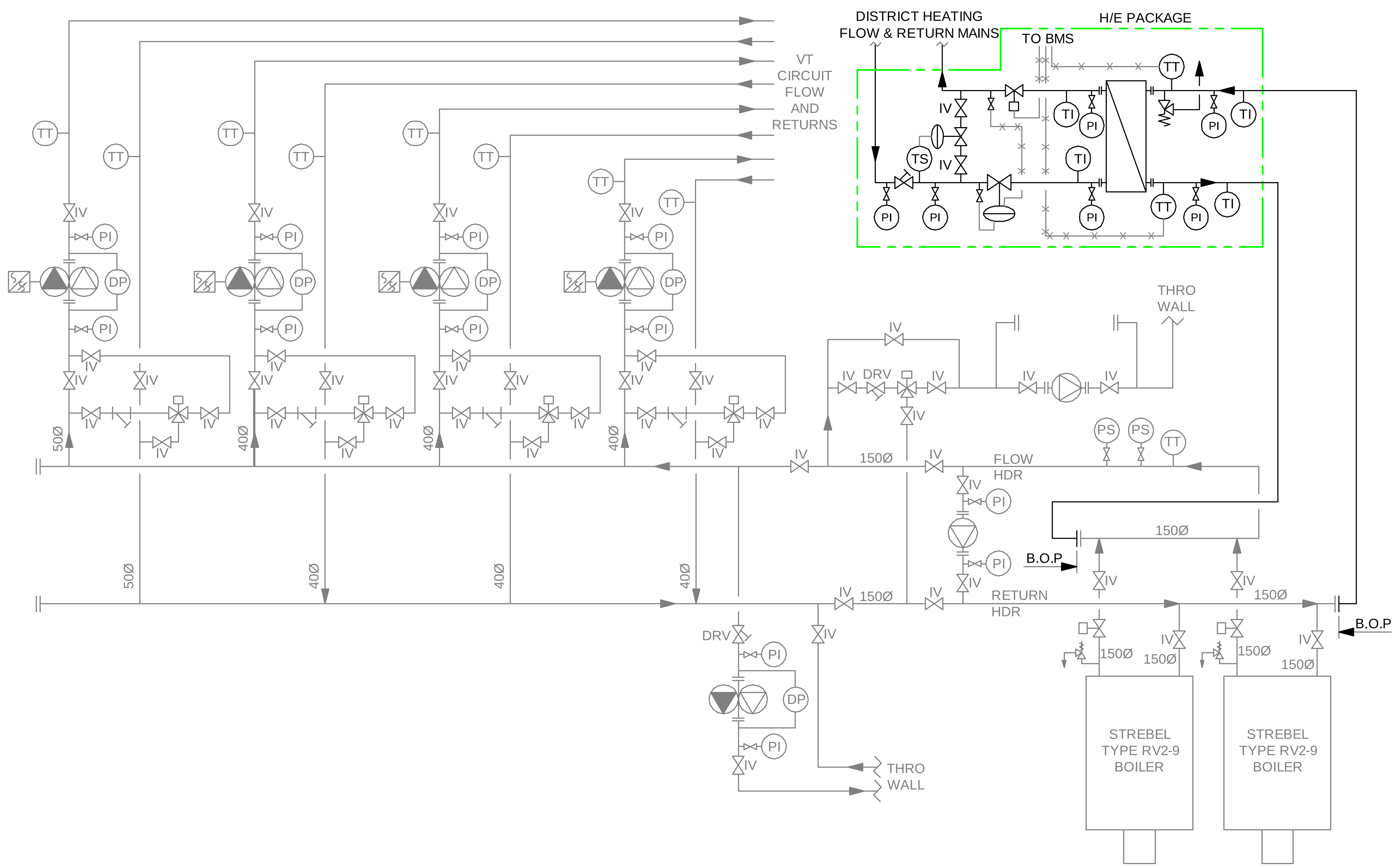


TOWER BOILER ROOM
PLAN LOCATED ON ROOF
OF BUILDING



LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV — 3 PORT CONTROL VALVE
- CV — 2 PORT CONTROL VALVE
- PICV — PRESSURE INDEPENDANT CONTROL VALVE
- CS — COMMISSIONING STATION
- PRESSURE RELIEF VALVE
- SELF ACTING DIFFERENTIAL PRESSURE CONTROL VALVE
- T — TEMPERATURE SENSOR
- TI — TEMPERATURE INDICATOR
- PI — PRESSURE INDICATOR
- PUMP
- DPS — DIFFERENTIAL PRESSURE SENSOR
- B.P. — BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

PB PARSONS BRINCKERHOFF 125 YEARS

Energy Solutions - Infrastructure

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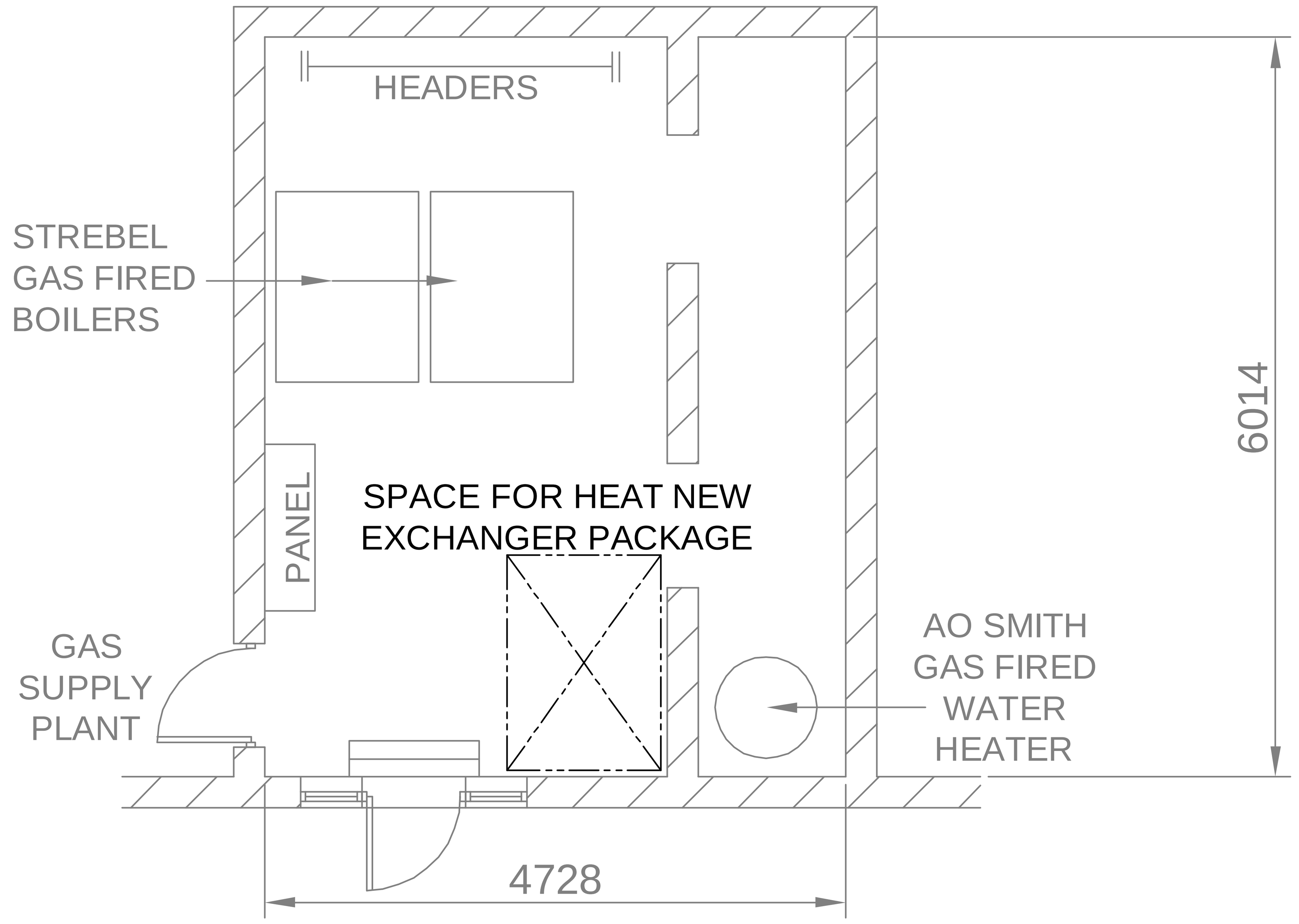
Tel: 44-(0)20-7337-1700 Fax: 44-(0)20-7337-1701

- CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN
- TITLE
LAYOUT OF DH CONNECTION TO COLLEGE OF NORTH LONDON TOWER BOILER ROOM

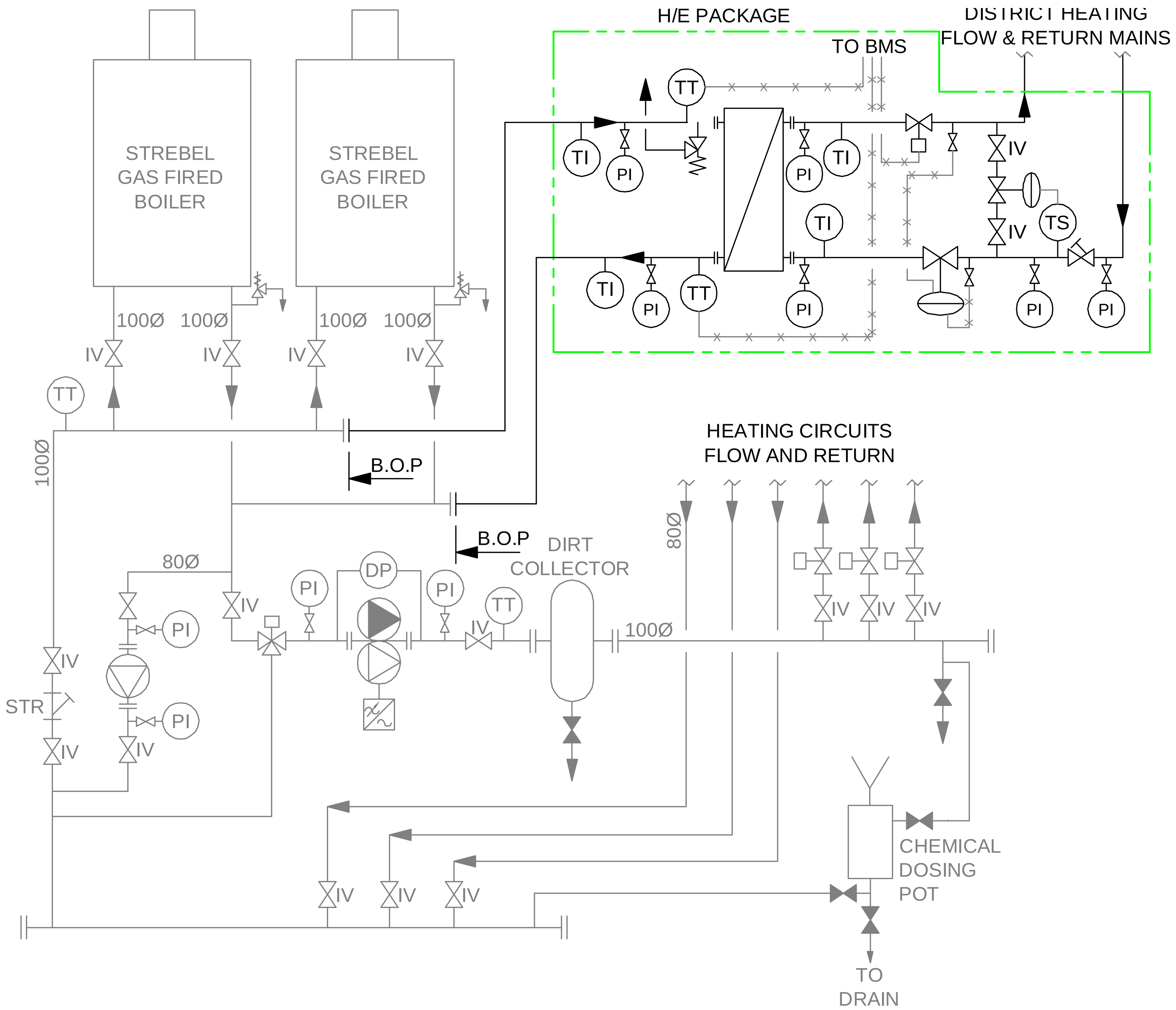
- DATE 06/04/12
- SCALE 1/100@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
3511559A-BEL-1-M011 A



BOILER ROOM
PLAN



LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV 3 PORT CONTROL VALVE
- CV 2 PORT CONTROL VALVE
- PICV PRESSURE INDEPENDANT CONTROL VALVE
- CS COMMISSIONING STATION
- PRESSURE RELIEF VALVE
- SELF ACTING DIFFERENTIAL PRESSURE CONTROL VALVE
- T TEMPERATURE SENSOR
- TI TEMPERATURE INDICATOR
- PI PRESSURE INDICATOR
- PUMP
- DPS DIFFERENTIAL PRESSURE SENSOR
- B.P. BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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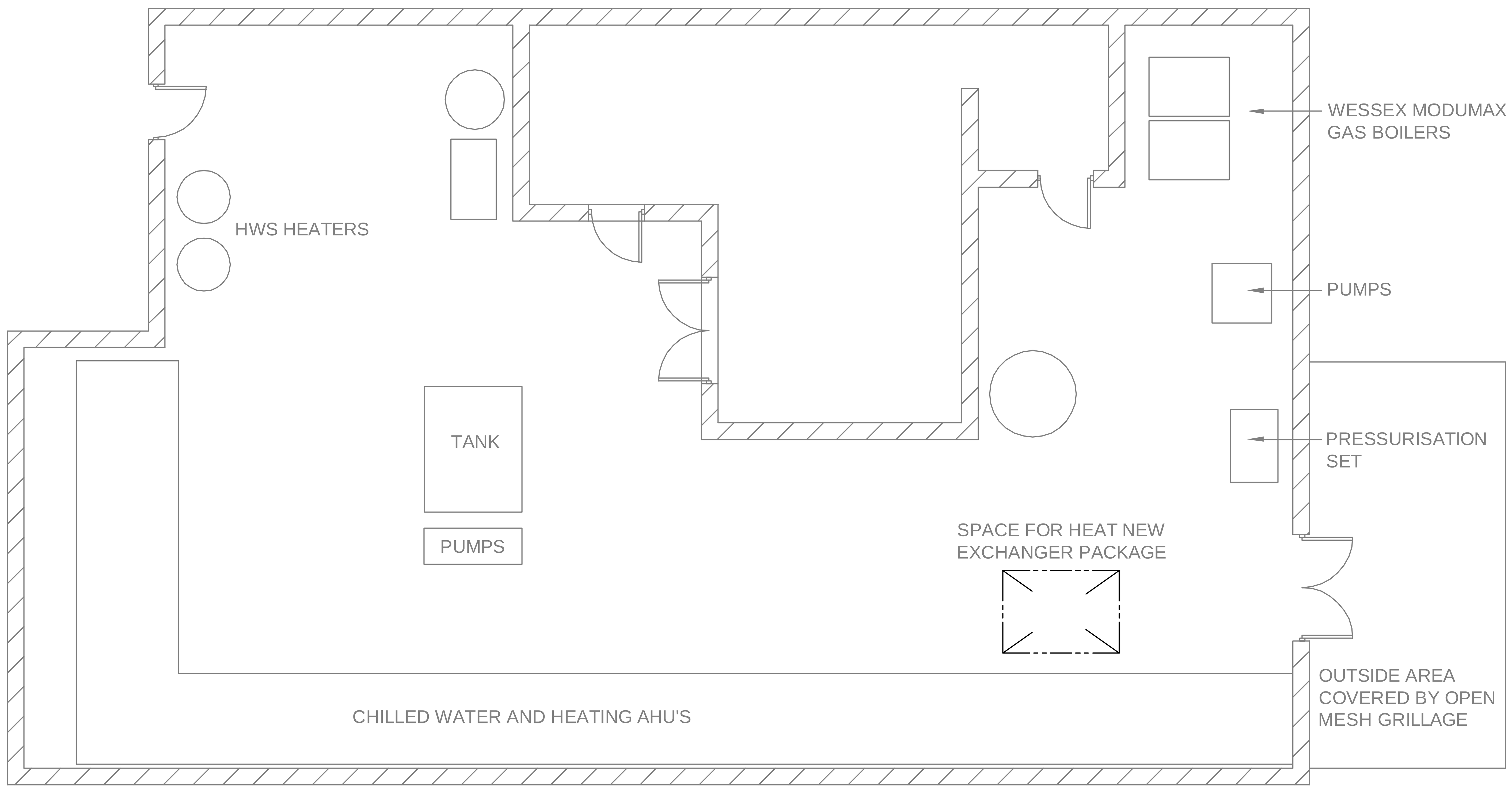
Tel: 44-(0)20-7337-1700 Fax: 44-(0)20-7337-1701

CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN

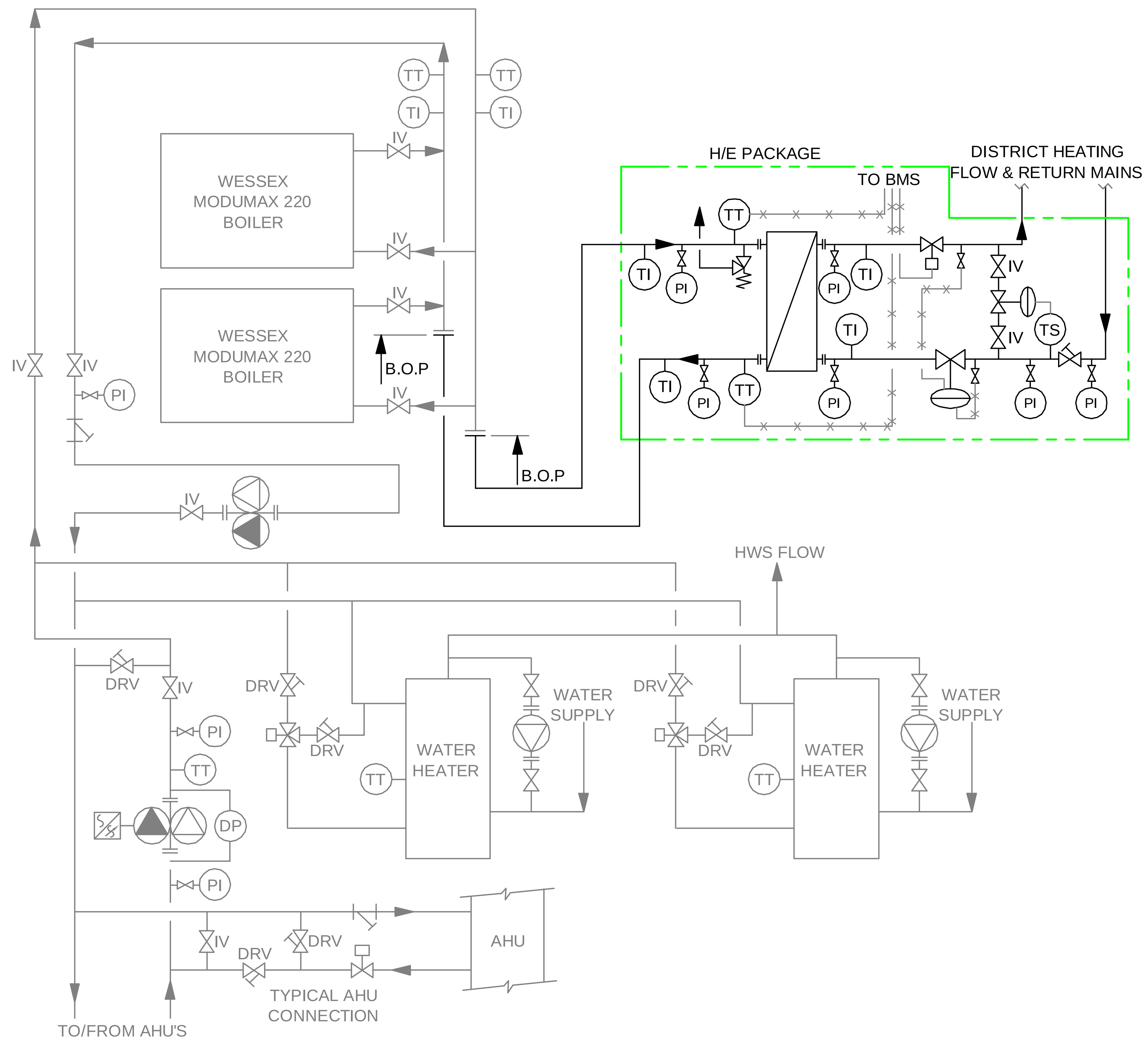
TITLE
LAYOUT OF DH CONNECTION TO COLLEGE OF NORTH LONDON BLR ROOM NEXT TO B/GRANT CENTRE

DATE	13/04/12	DRAWN BY	RAYK
SCALE	1/75@A3	PRODUCED BY	
CAD REF		CHECKED	RB
		APPROVED	RB

DRAWING NUMBER
3511559A-BEL-1-M013 A



BASEMENT BOILER ROOM PLAN



LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV — 3 PORT CONTROL VALVE
- CV — 2 PORT CONTROL VALVE
- PICV — PRESSURE INDEPENDANT CONTROL VALVE
- CS — COMMISSIONING STATION
- PRESSURE RELIEF VALVE
- SELF ACTING DIFFERENTIAL PRESSURE CONTROL VALVE
- T — TEMPERATURE SENSOR
- TI — TEMPERATURE INDICATOR
- PI — PRESSURE INDICATOR
- PUMP
- DPS — DIFFERENTIAL PRESSURE SENSOR
- B.P. — BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

PARSONS BRINCKERHOFF
125 YEARS

Energy Solutions - Infrastructure

6 Devonshire Square, London EC2M 4YE, UK
Tel: 44-(0)20-7337-1700 Fax: 44-(0)20-7337-1701

- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  LAYOUT OF DH CONNECTION TO BERNIE GRANT ARTS CENTRE BOILER ROOM

DATE	13/04/12	DRAWN BY	RAYK
SCALE	1/100@A3	PRODUCED BY	
CAD REF		CHECKED	RB
		APPROVED	RB

- DRAWING NUMBER
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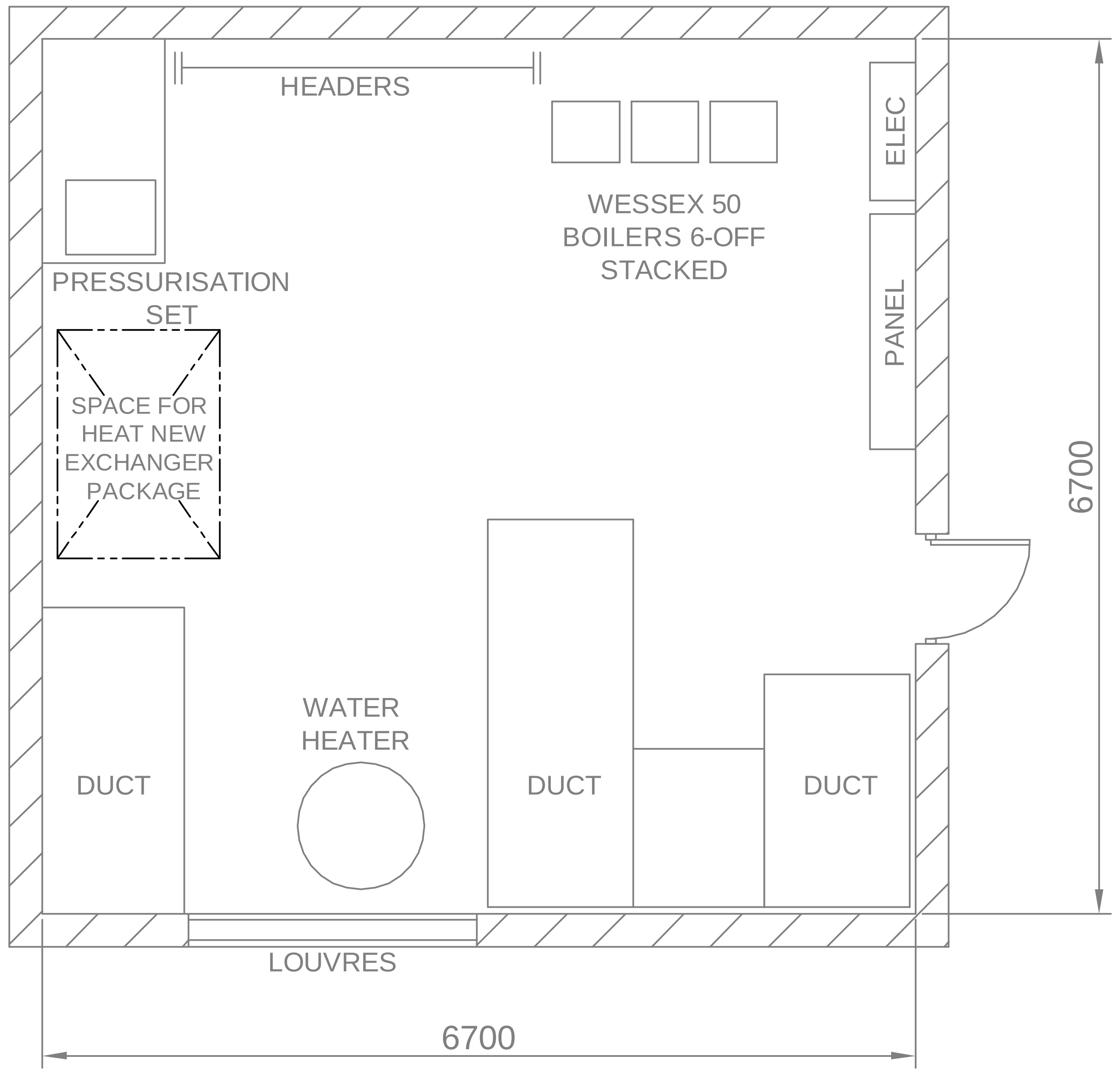
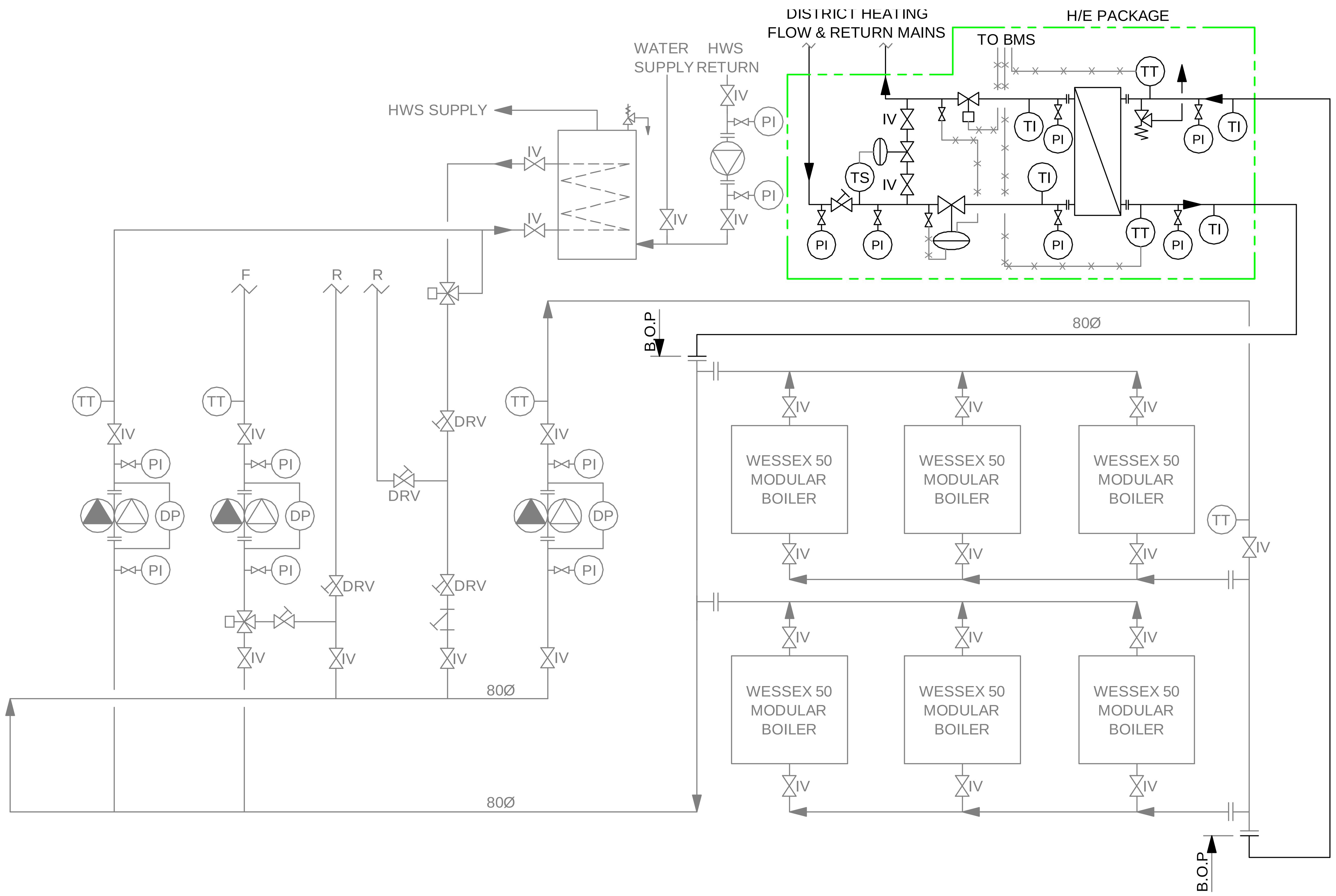


BOILER ROOM
PLAN



LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV 3 PORT CONTROL VALVE
- CV 2 PORT CONTROL VALVE
- PICV PRESSURE INDEPENDANT CONTROL VALVE
- CS COMMISSIONING STATION
- PRESSURE RELIEF VALVE
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- T TEMPERATURE SENSOR
- TI TEMPERATURE INDICATOR
- PI PRESSURE INDICATOR
- PUMP
- DPS DIFFERENTIAL PRESSURE SENSOR
- B.P. BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

PARSONS BRINCKERHOFF
125 YEARS

Energy Solutions - Infrastructure

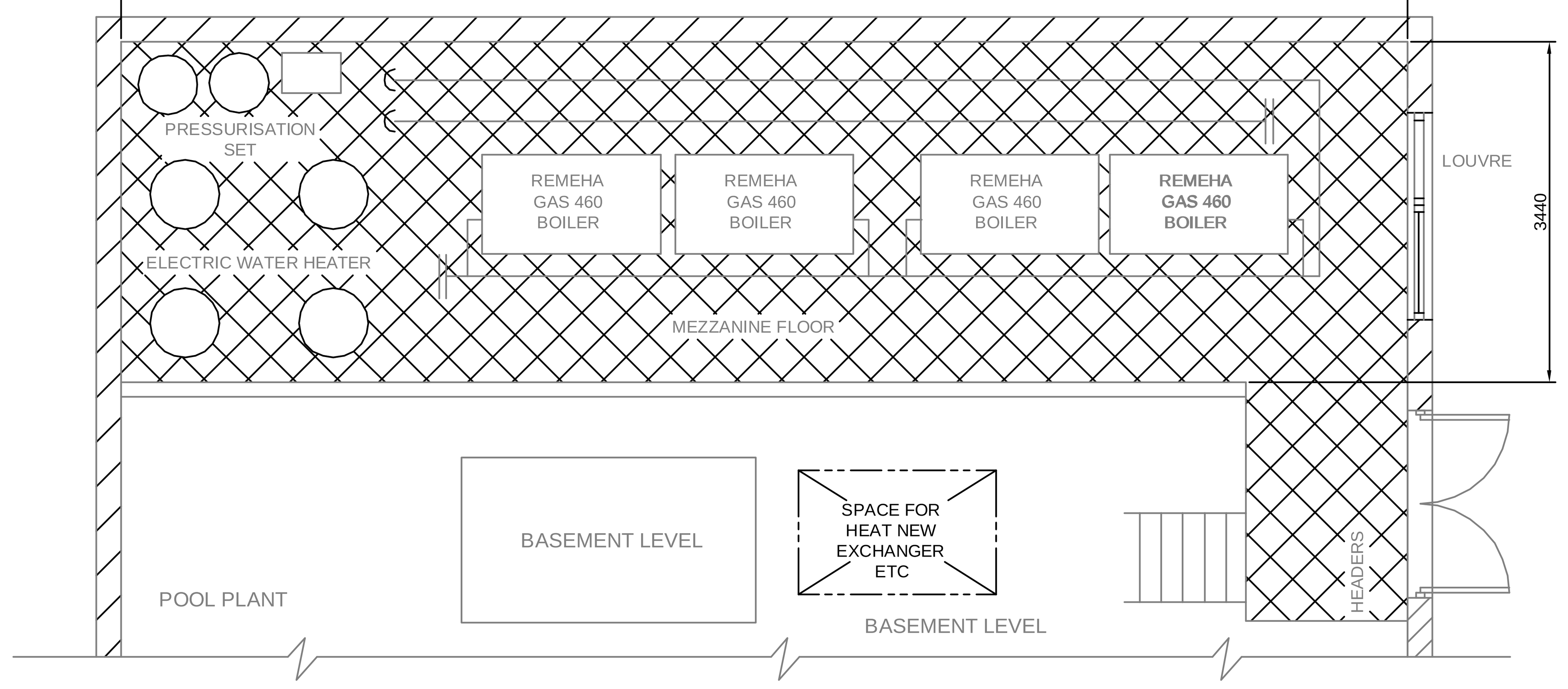
6 Devonshire Square, London EC2M 4YE, UK
Tel: 44-(0)20-7337-1700 Fax: 44-(0)20-7337-1701

- CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN
- TITLE
LAYOUT OF DH CONNECTION TO COLLEGE OF NORTH LONDON CENTENARY BOILER ROOM

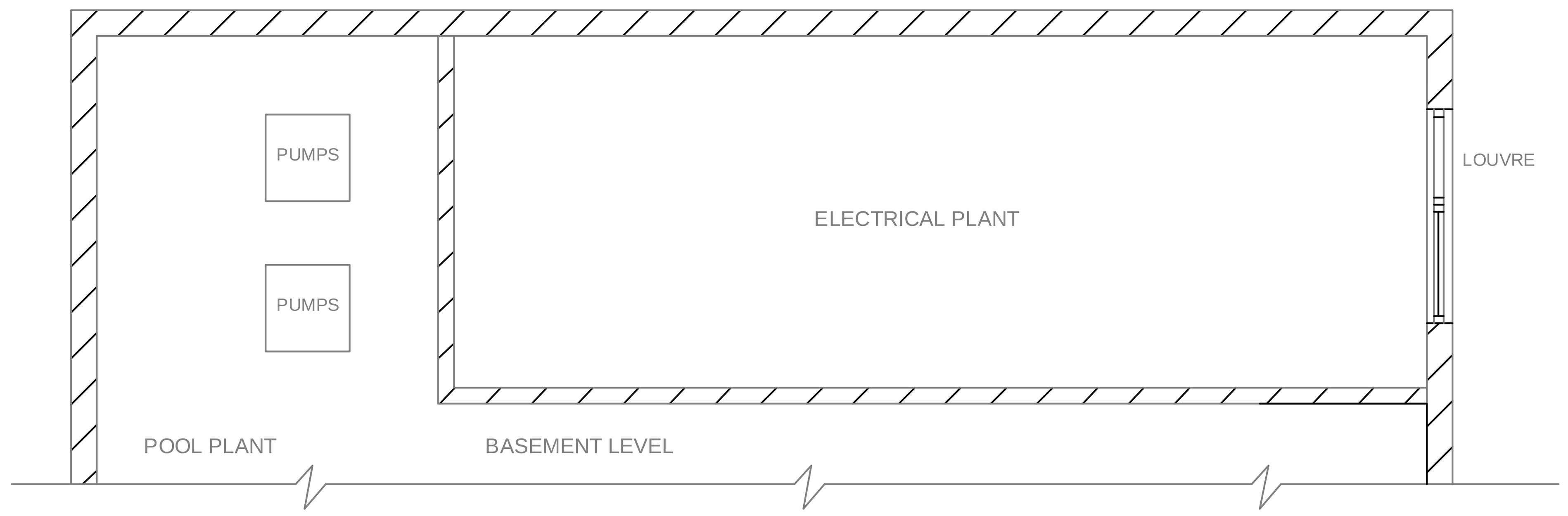
- DATE 010/04/12
- SCALE 1/75@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

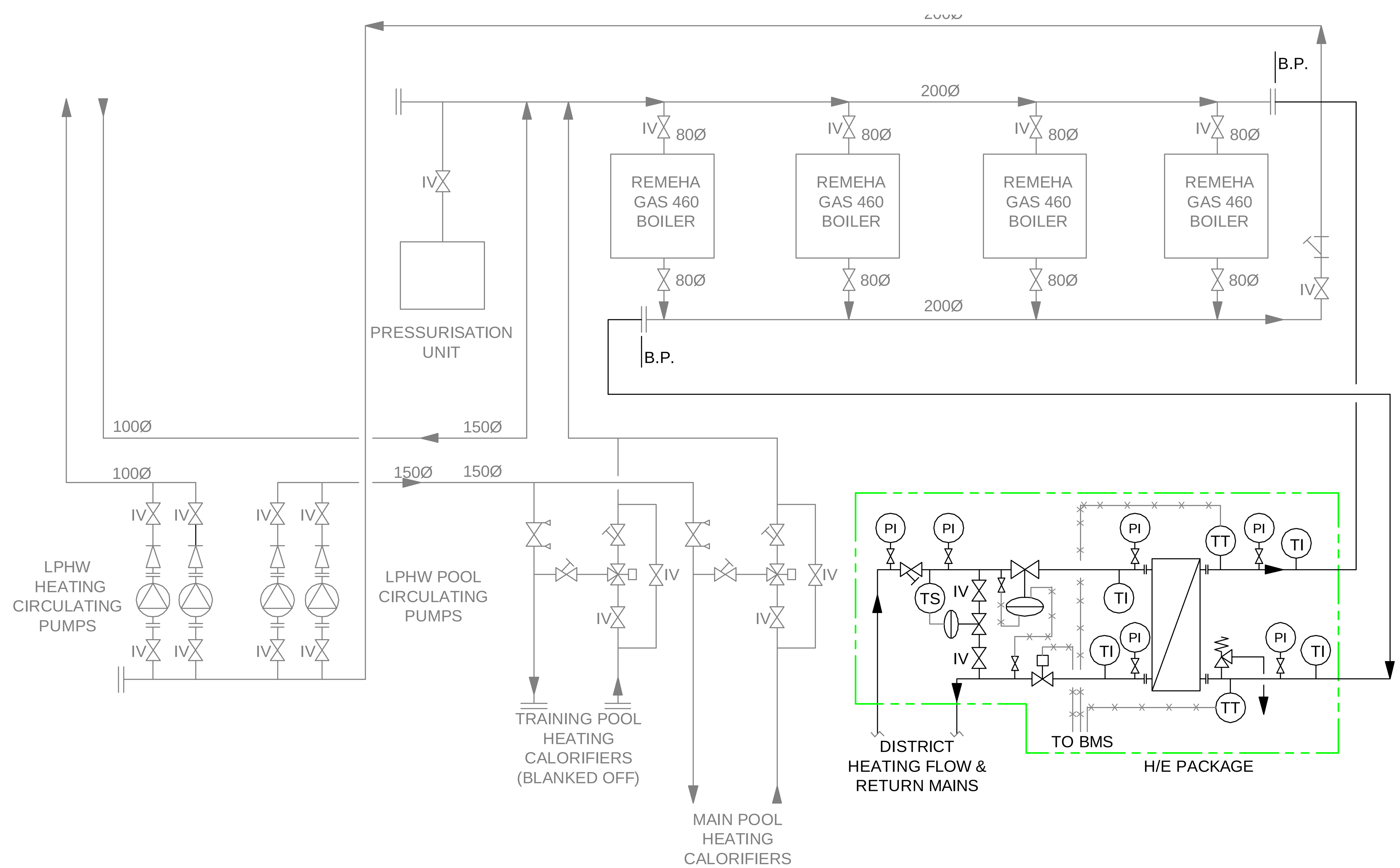
- DRAWING NUMBER
3511559A-BEL-1-M012 A



PLAN ON MEZZANINE FLOOR



PLAN ON BASEMENT



LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV — 3 PORT CONTROL VALVE
- CV — 2 PORT CONTROL VALVE
- PICV — PRESSURE INDEPENDANT CONTROL VALVE
- CS — COMMISSIONING STATION
- PRESSURE RELIEF VALVE
- SELF ACTING DIFFERENTIAL PRESSURE CONTROL VALVE
- T — TEMPERATURE SENSOR
- TI — TEMPERATURE INDICATOR
- PI — PRESSURE INDICATOR
- PUMP
- DPS — DIFFERENTIAL PRESSURE SENSOR
- B.P. — BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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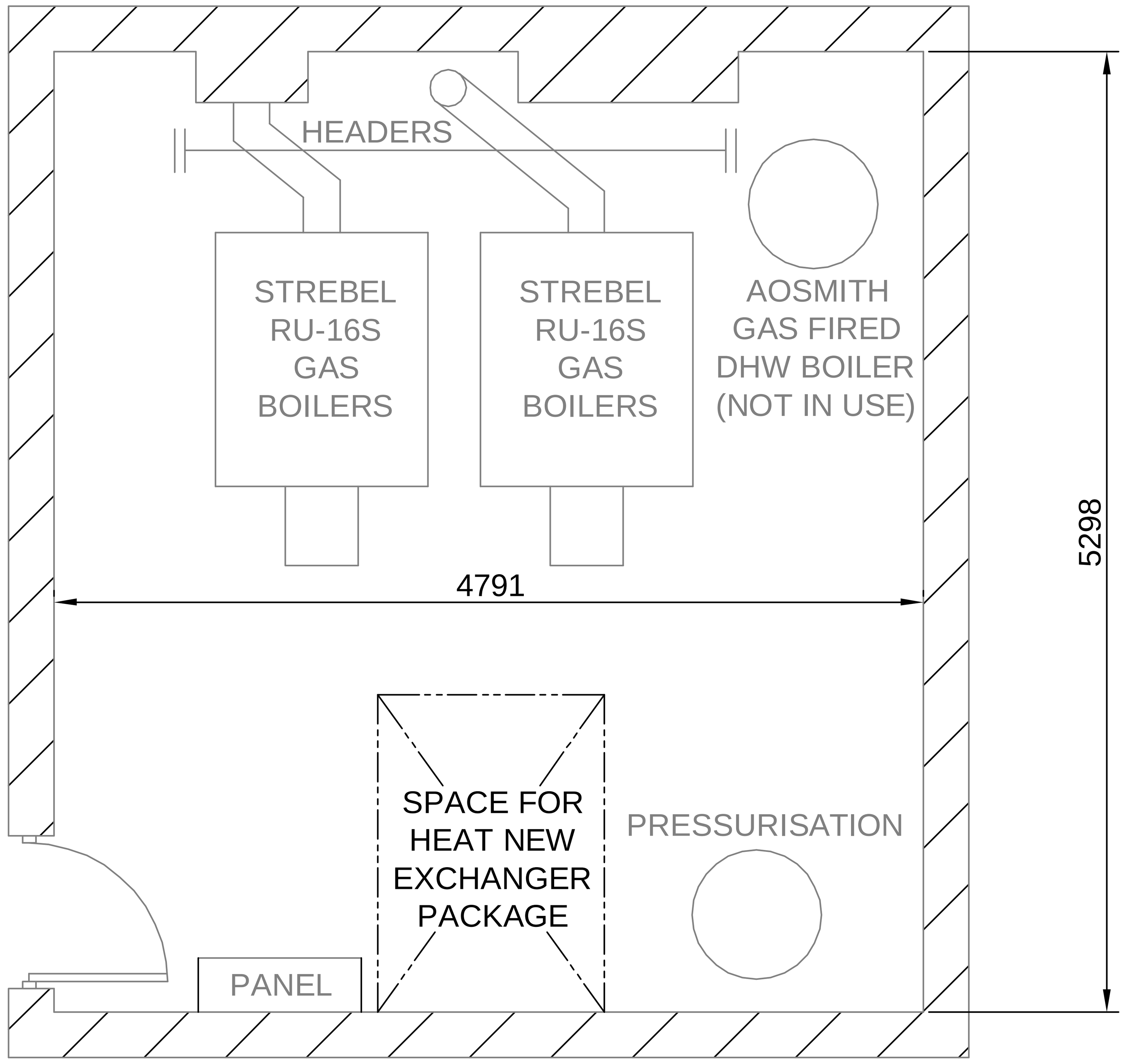
- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  LAYOUT OF DH CONNECTION TO TOTTENHAM GREEN LEISURE CENTRE PLANTROOM

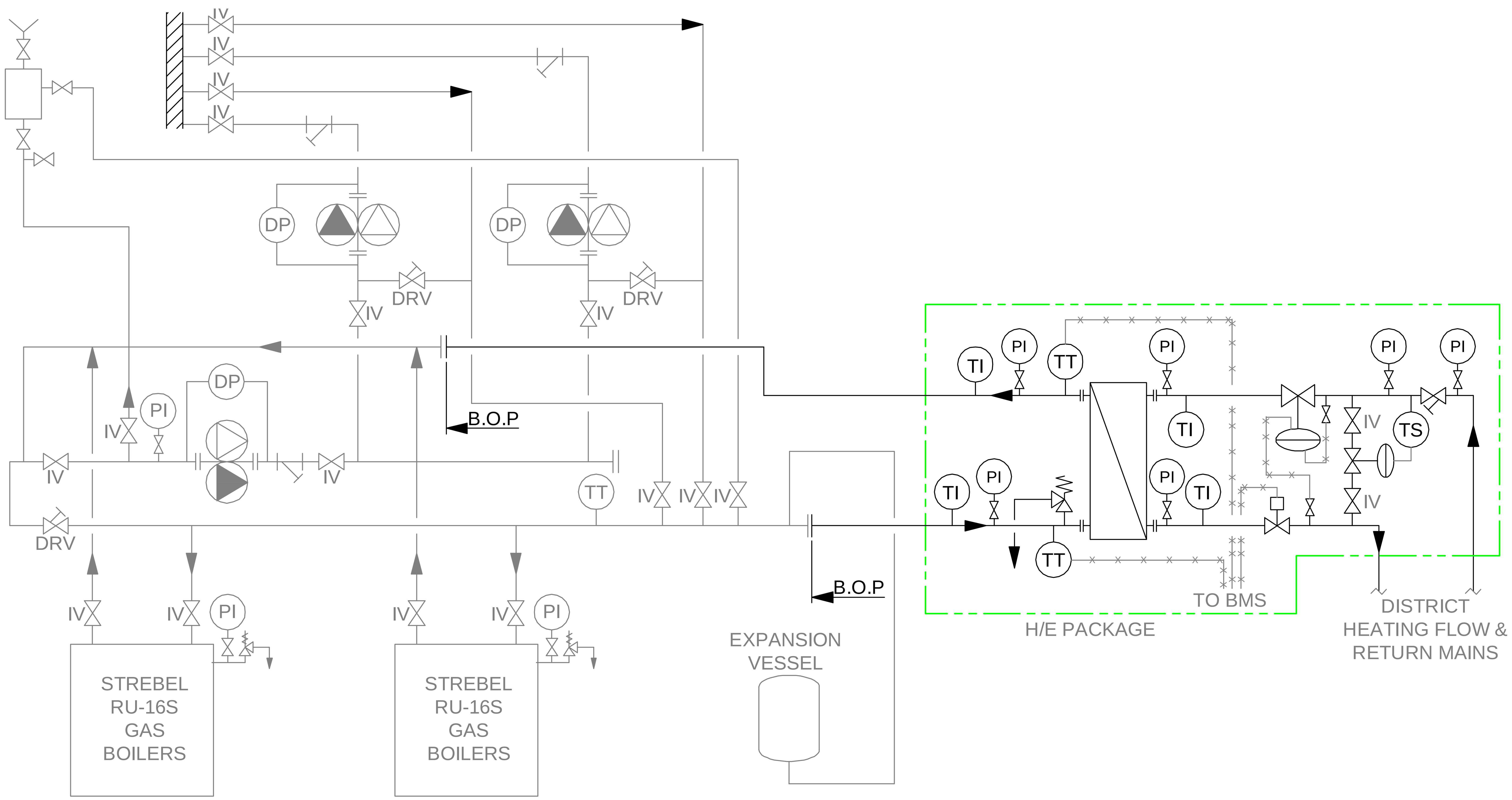
- DATE 09/03/12
- SCALE 1/100
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
  3511559A-BEL-1-M006 A



PLAN OF EXISTING PLANTROOM



LEGEND
- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV — 3 PORT CONTROL VALVE
- CV — 2 PORT CONTROL VALVE
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- DPS — DIFFERENTIAL PRESSURE SENSOR
- B.P. — BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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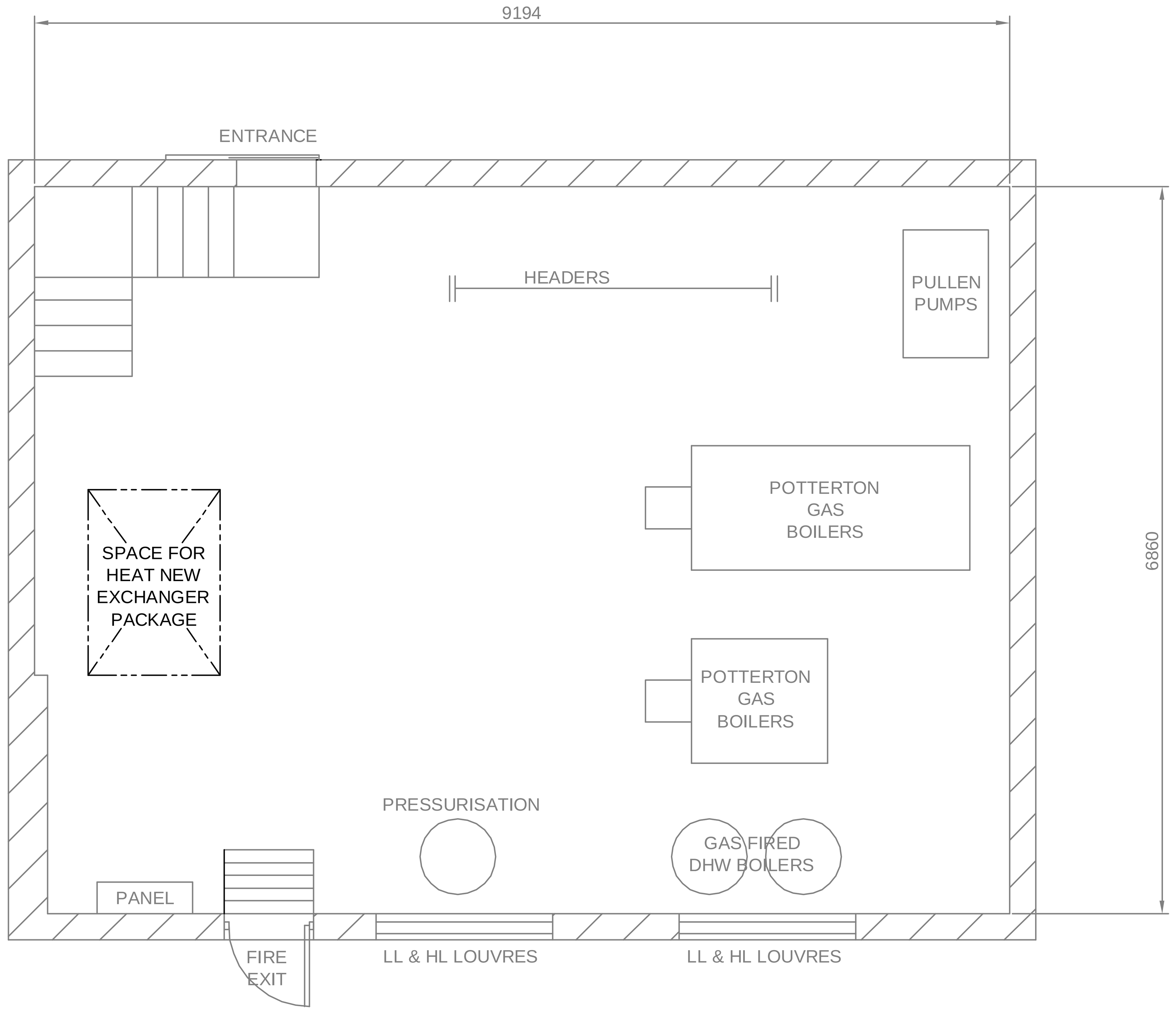
CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN

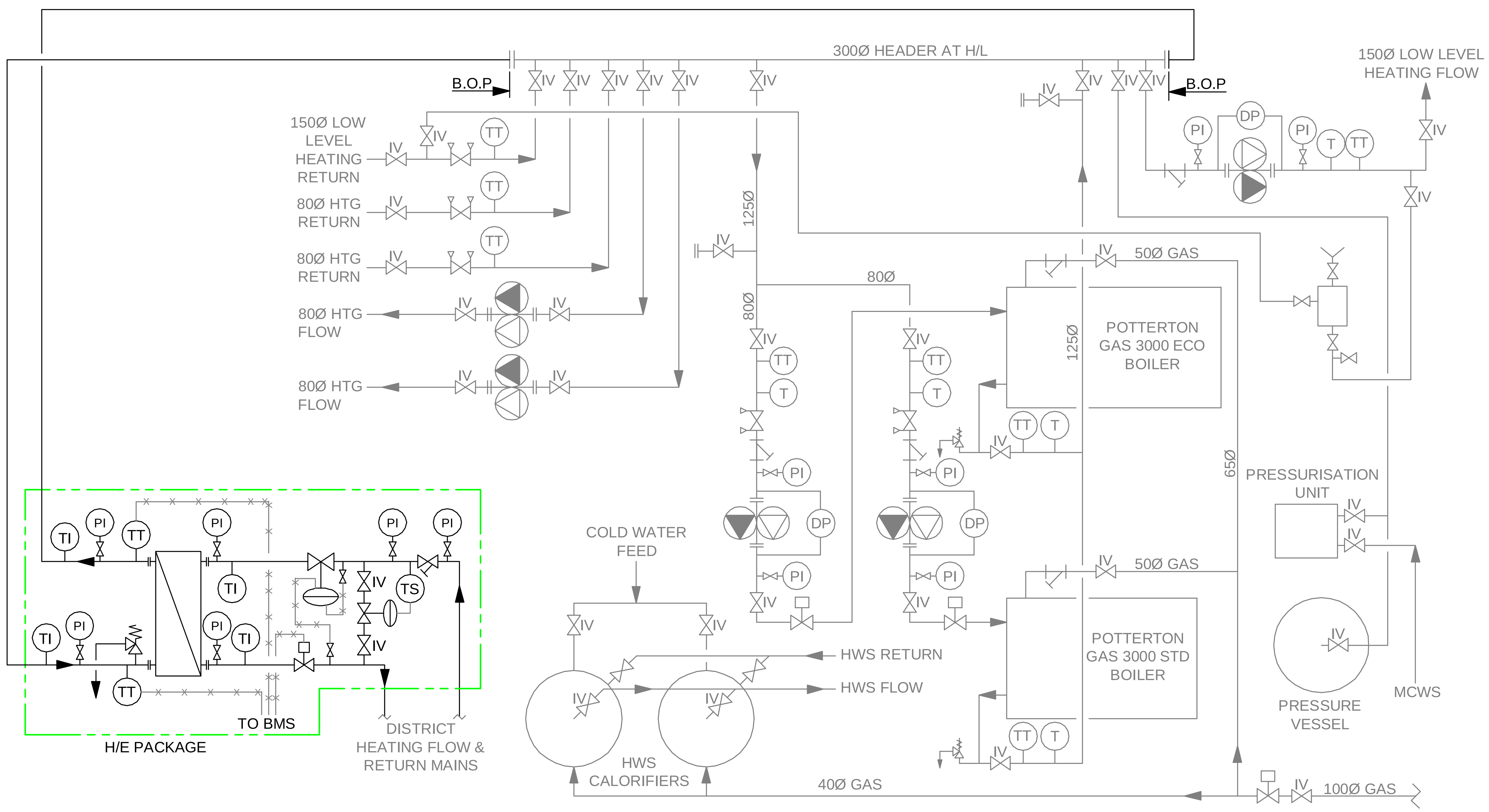
TITLE
LAYOUT OF DH CONNECTION TO TOTTENHAM TOWN HALL PLANTROOM

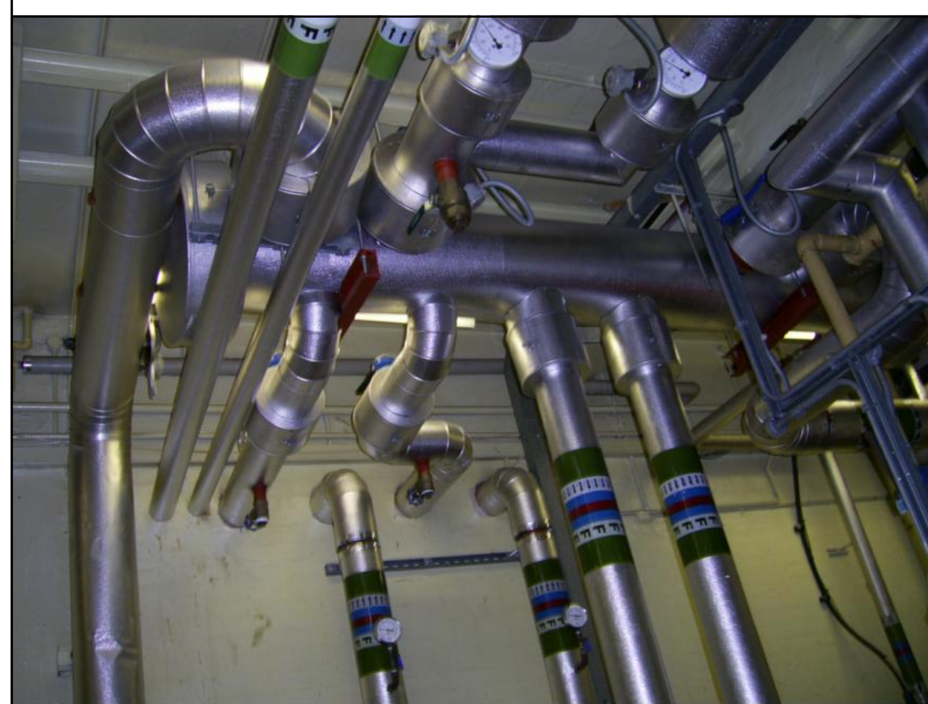
DATE	09/03/12	DRAWN BY	RAYK
SCALE	1/50@A3	PRODUCED BY	
CAD REF		CHECKED	RB
		APPROVED	RB

DRAWING NUMBER
3511559A-BEL-1-M007 A



PLAN OF EXISTING PLANTROOM





LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV 3 PORT CONTROL VALVE
- CV 2 PORT CONTROL VALVE
- PRESSURE RELIEF VALVE
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- T TEMPERATURE SENSOR
- TI TEMPERATURE INDICATOR
- PI PRESSURE INDICATOR
- PUMP
- B.P. BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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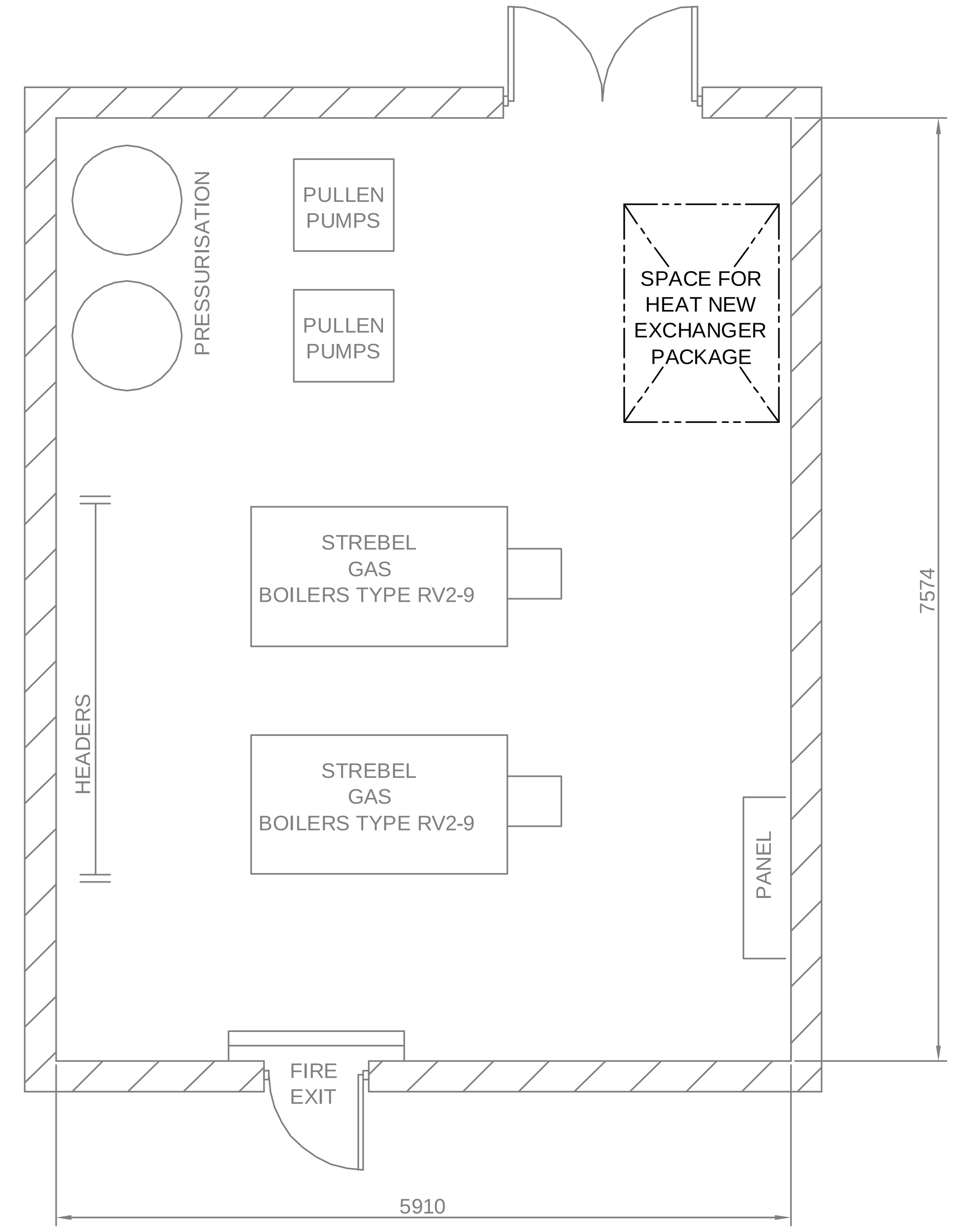
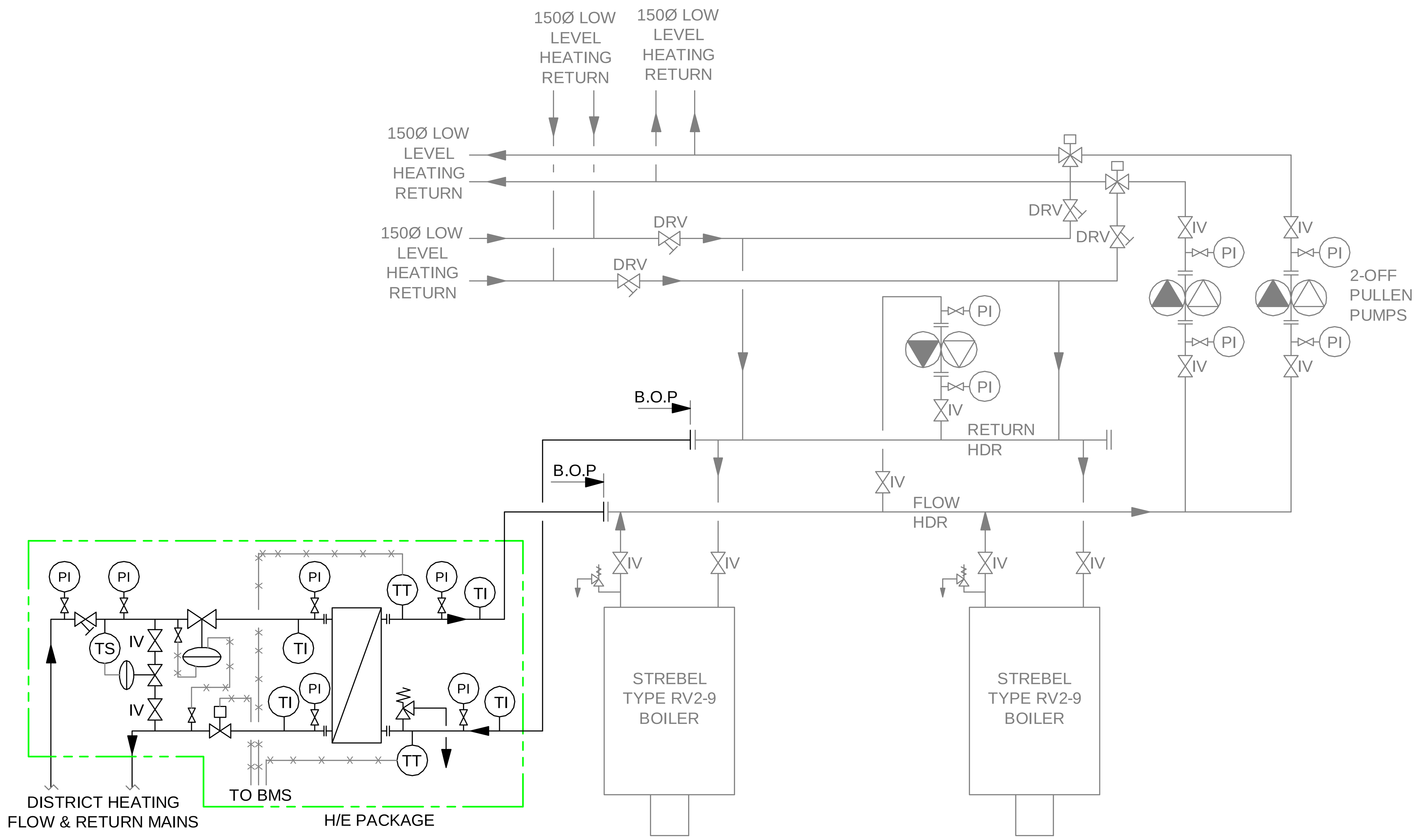
CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN

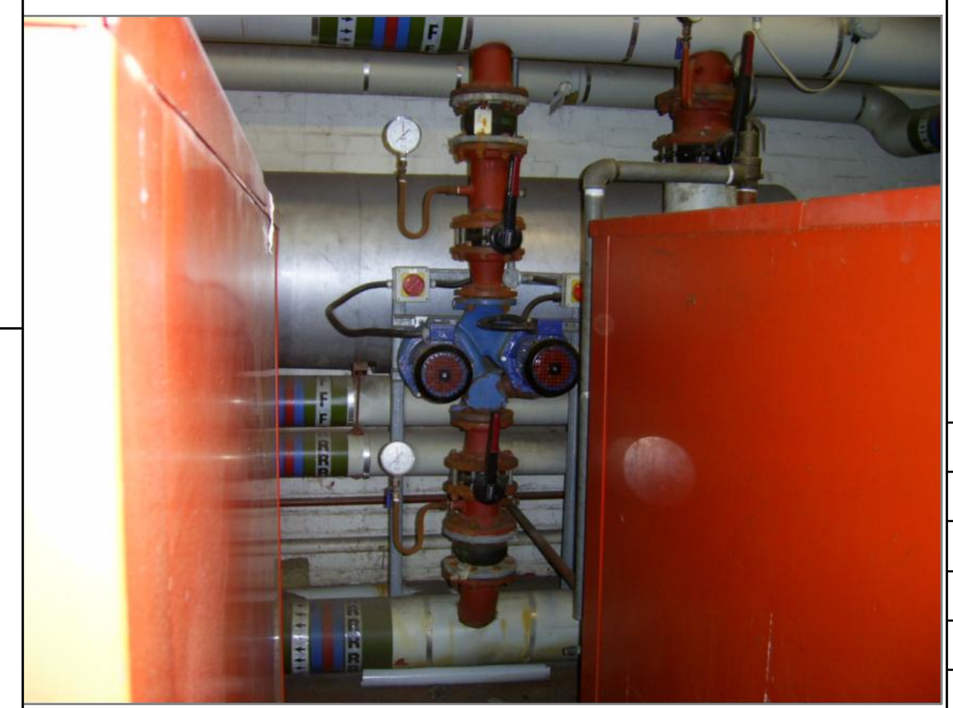
TITLE
LAYOUT OF DH CONNECTION TO COLLEGE OF NORTH LONDON MAIN BOILER ROOM

DATE 23/03/12
SCALE 1/75@A3
CAD REF
DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

DRAWING NUMBER
3511559A-BEL-1-M009 A







LEGEND

- ISOLATION VALVE
- NON-RETURN VALVE
- DOUBLE REGULATING VALVE
- STRAINER
- CV 3 PORT CONTROL VALVE
- CV 2 PORT CONTROL VALVE
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- T TEMPERATURE SENSOR
- TI TEMPERATURE INDICATOR
- PI PRESSURE INDICATOR
- PUMP
- DPS DIFFERENTIAL PRESSURE SENSOR
- B.P. BREAK IN POINT

REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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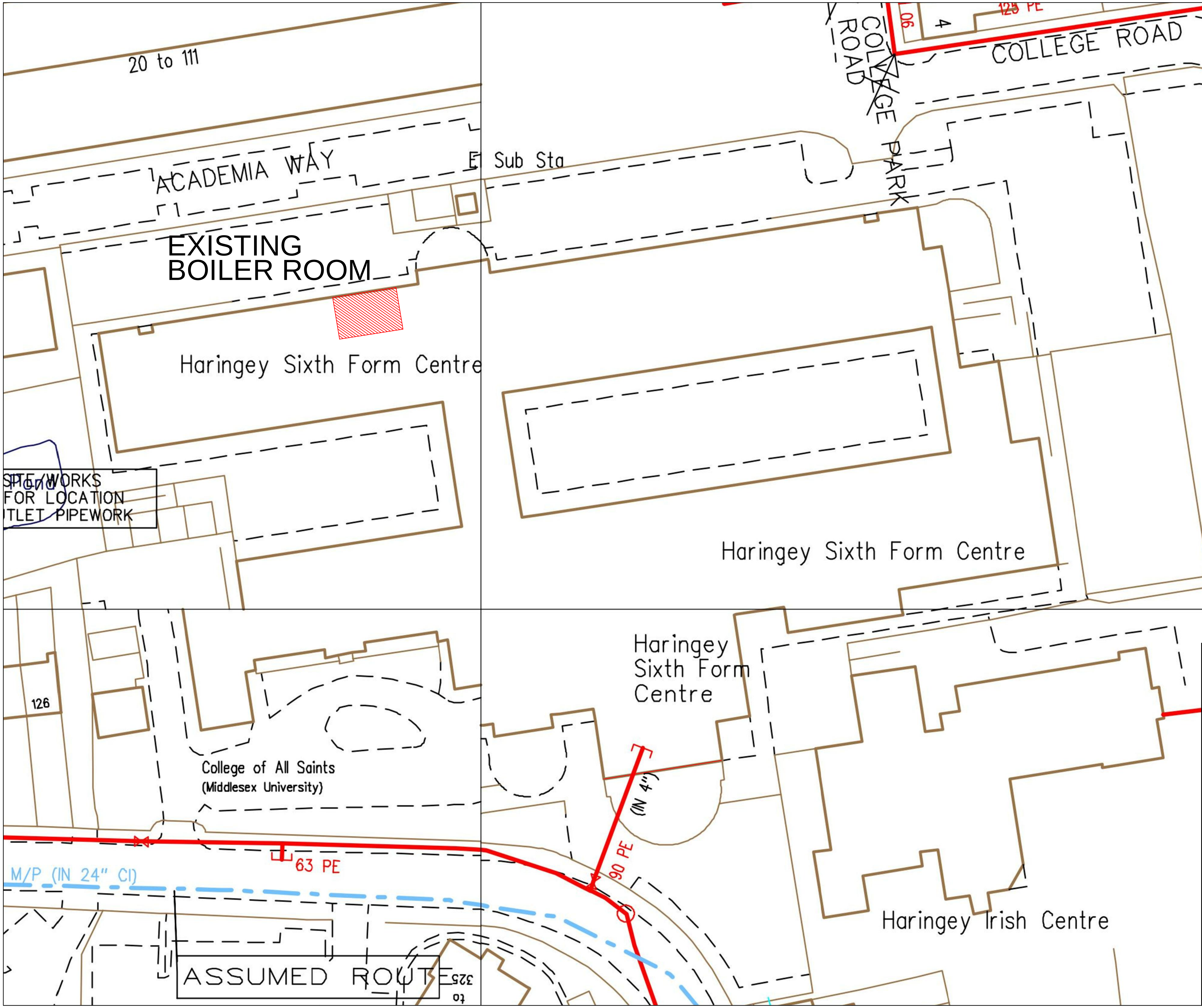
- CLIENT/PROJECT: NORTH LONDON STRATEGIC ALLIANCE UPPER LEE VALLEY DEN
- TITLE: LAYOUT OF DH CONNECTION TO COLLEGE OF NORTH LONDON BLOCK BOILER ROOM
- DATE: 06/04/12
- SCALE: 1/75@A3
- CAD REF
- DRAWN BY: RAYK
- PRODUCED BY
- CHECKED: RB
- APPROVED: RB
- DRAWING NUMBER: 3511559A-BEL-1-M010 A

White Hart Lane – Location and Plant Room Schematics



REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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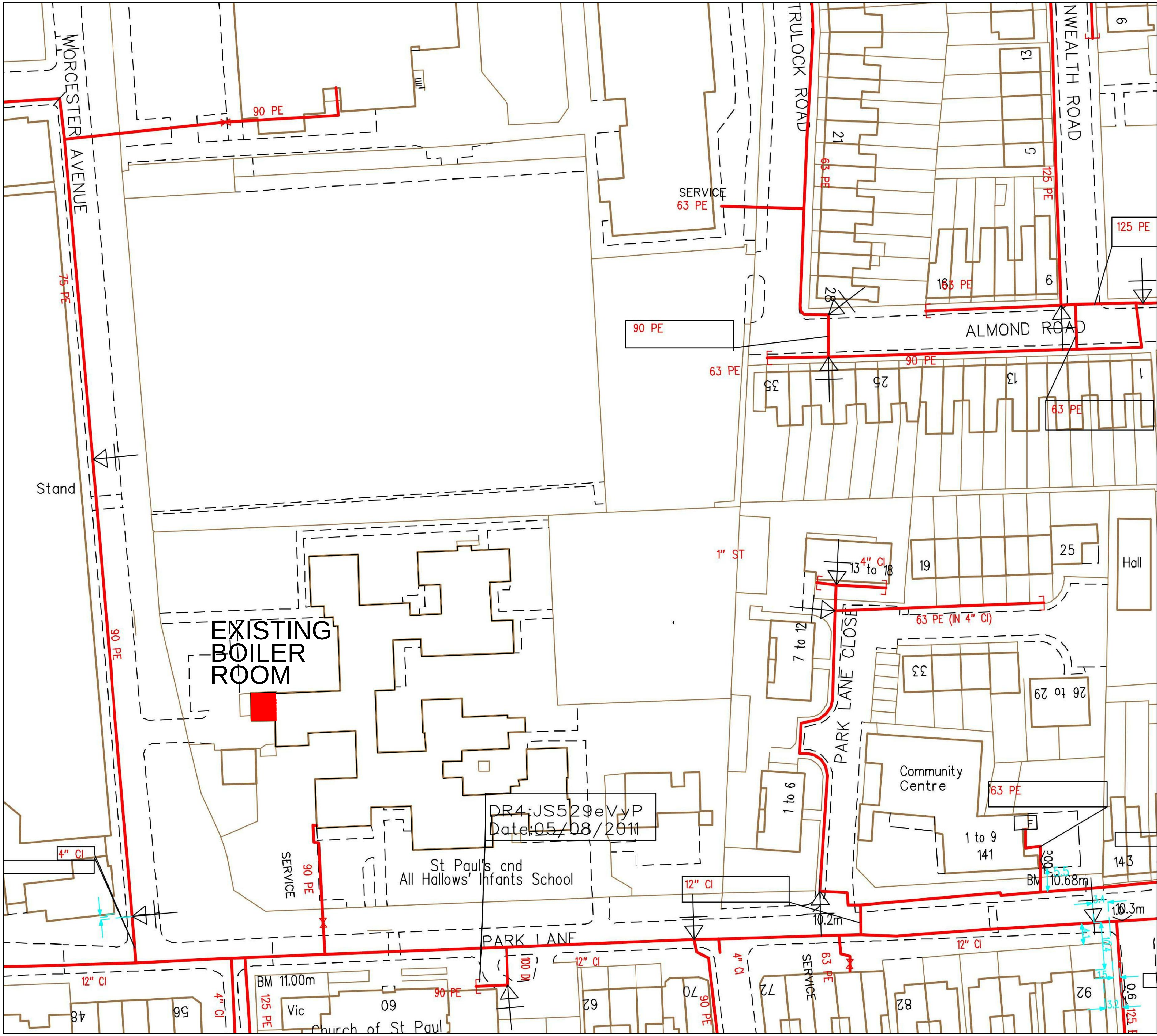
- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  LOCATION OF BOILER ROOM AT 6TH FORM COLLEGE

- DATE 16/04/12
- SCALE 1/500@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
  3511559A-BEL-1-M021 A



REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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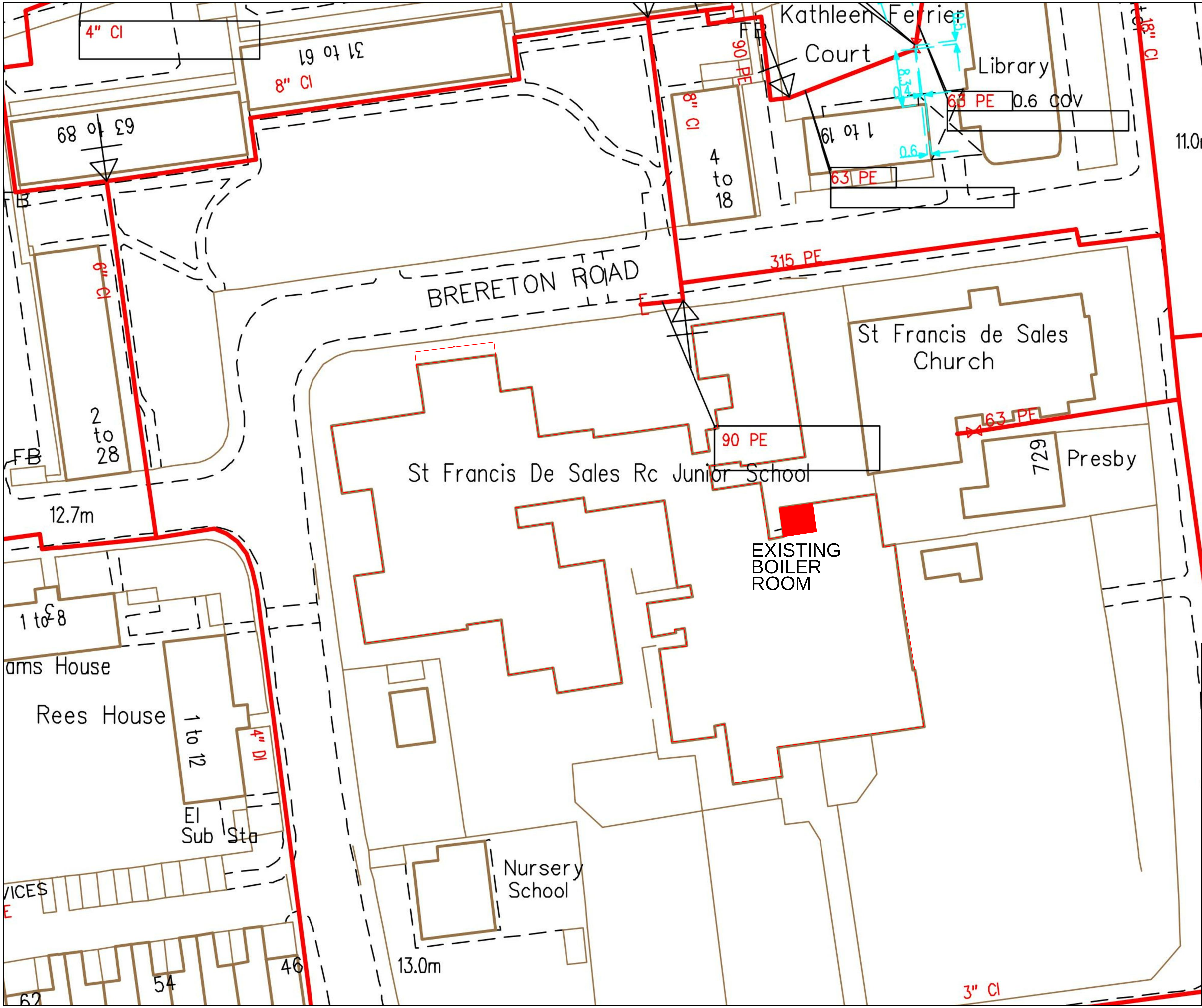
- CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN
- TITLE
LOCATION OF ST PAULS AND ALL HALLOWS BOILER ROOM

- DATE 17/04/12
- SCALE 1/750@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
3511559A-BEL-1-M022 A



A	ISSUED FOR COMMENT	RK	RB	RB	
REV.	DETAILS	DRN	CHK	APPR	DATE

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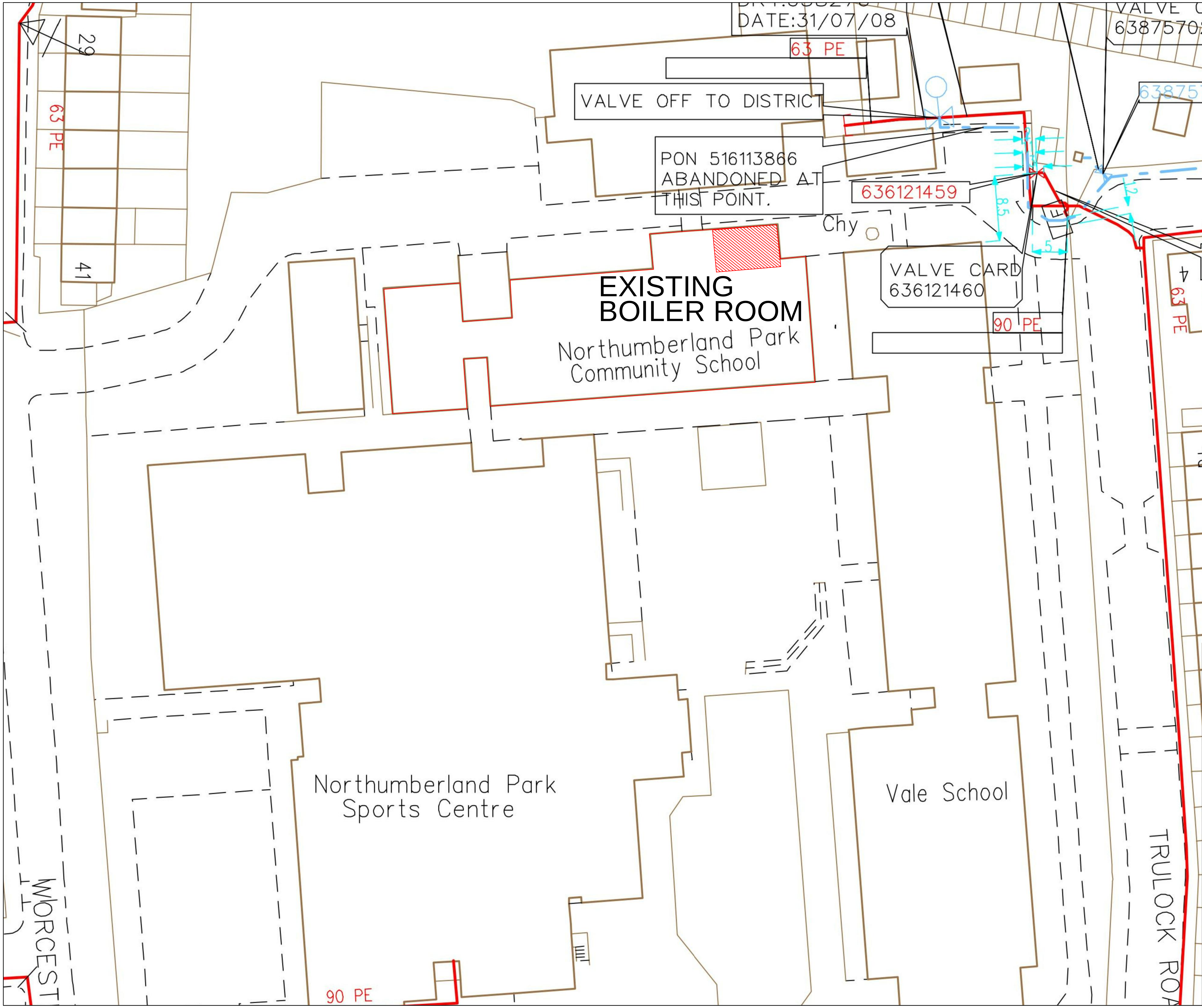
- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  LOCATION OF BOILER ROOM AT THE ST FRANCIS DE SALES RC JUNIOR SCHOOL

- DATE 02/0/12
- SCALE 1/500@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
  3511559A-BEL-1-M019 | A



REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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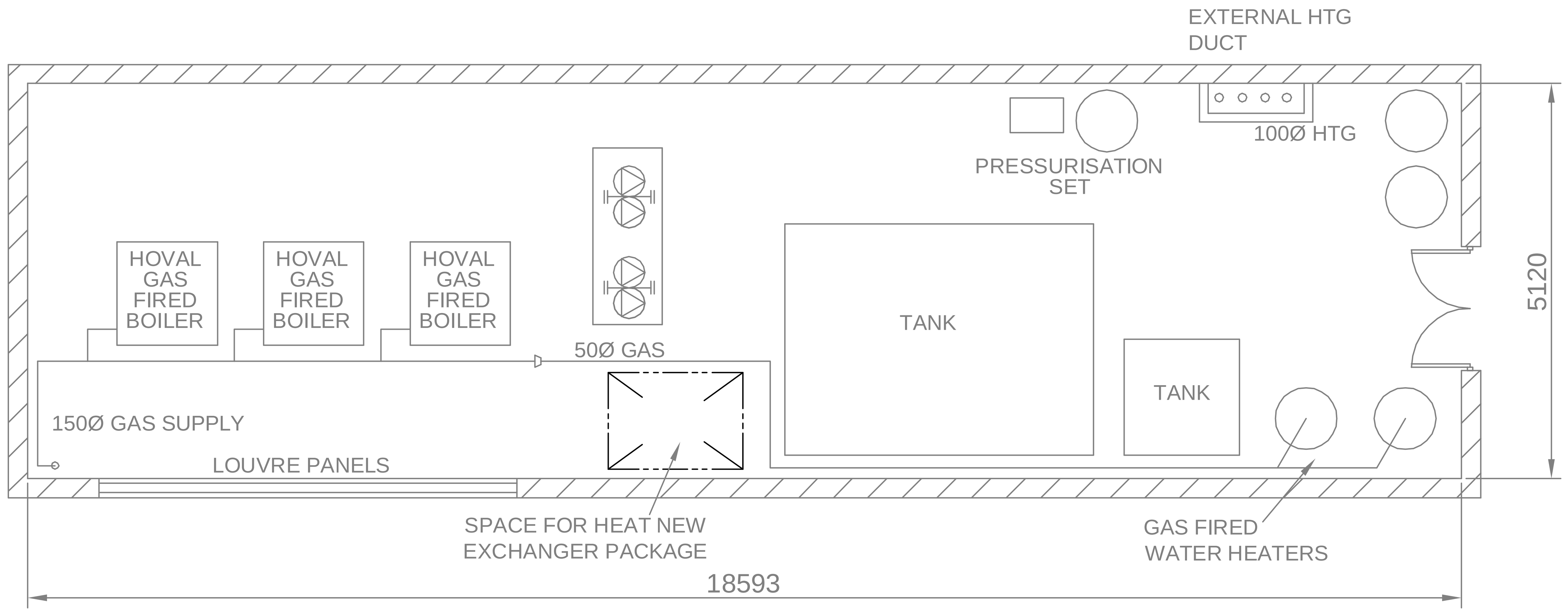
- CLIENT/PROJECT
  NORTH LONDON STRATEGIC ALLIANCE
  UPPER LEE VALLEY DEN
- TITLE
  LOCATION OF BOILER ROOM AT NORTHUMBERLAND PARK SCHOOL

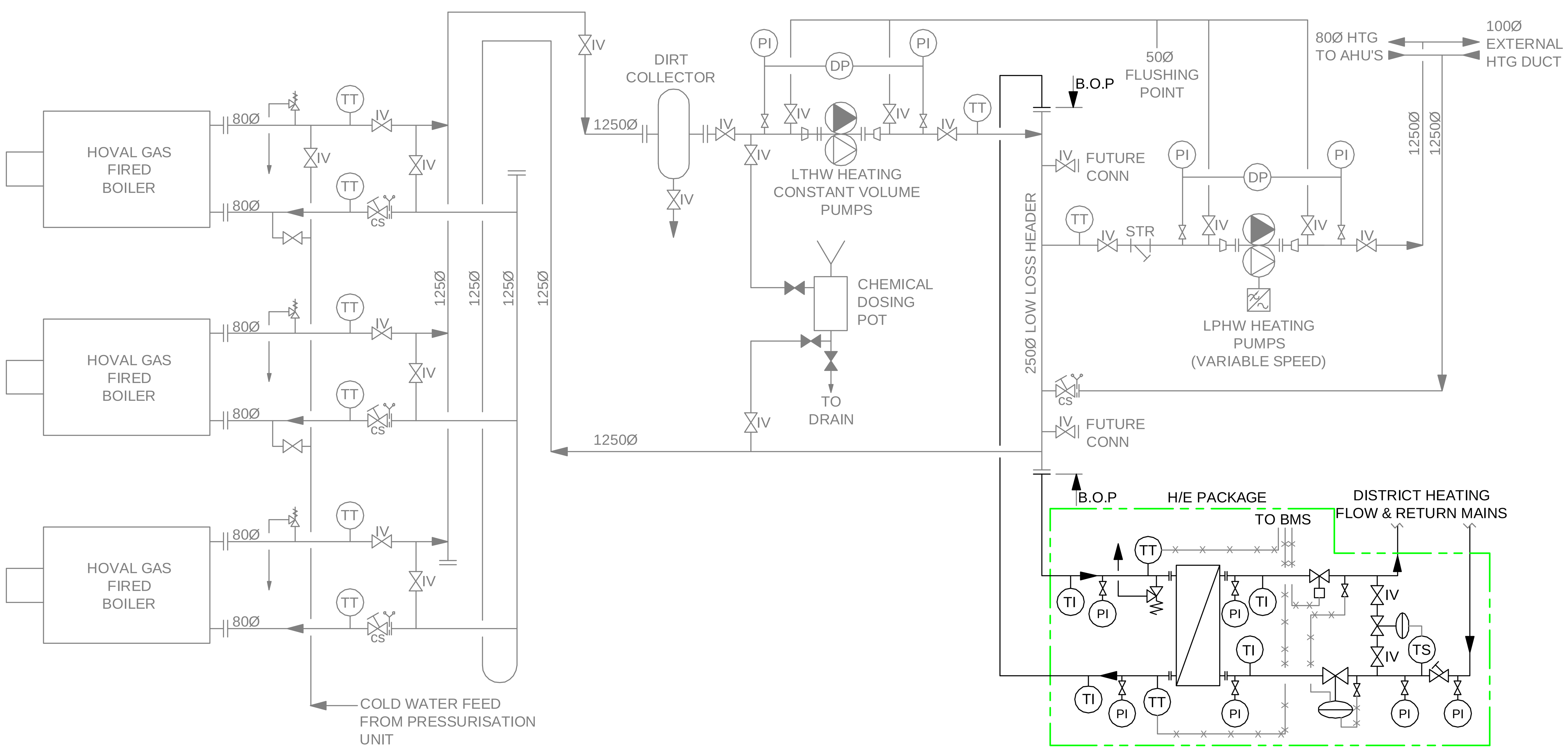
- DATE 04/04/12
- SCALE 1/750@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
  3511559A-BEL-1-M020 A



BOILER ROOM PLAN



LEGEND

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REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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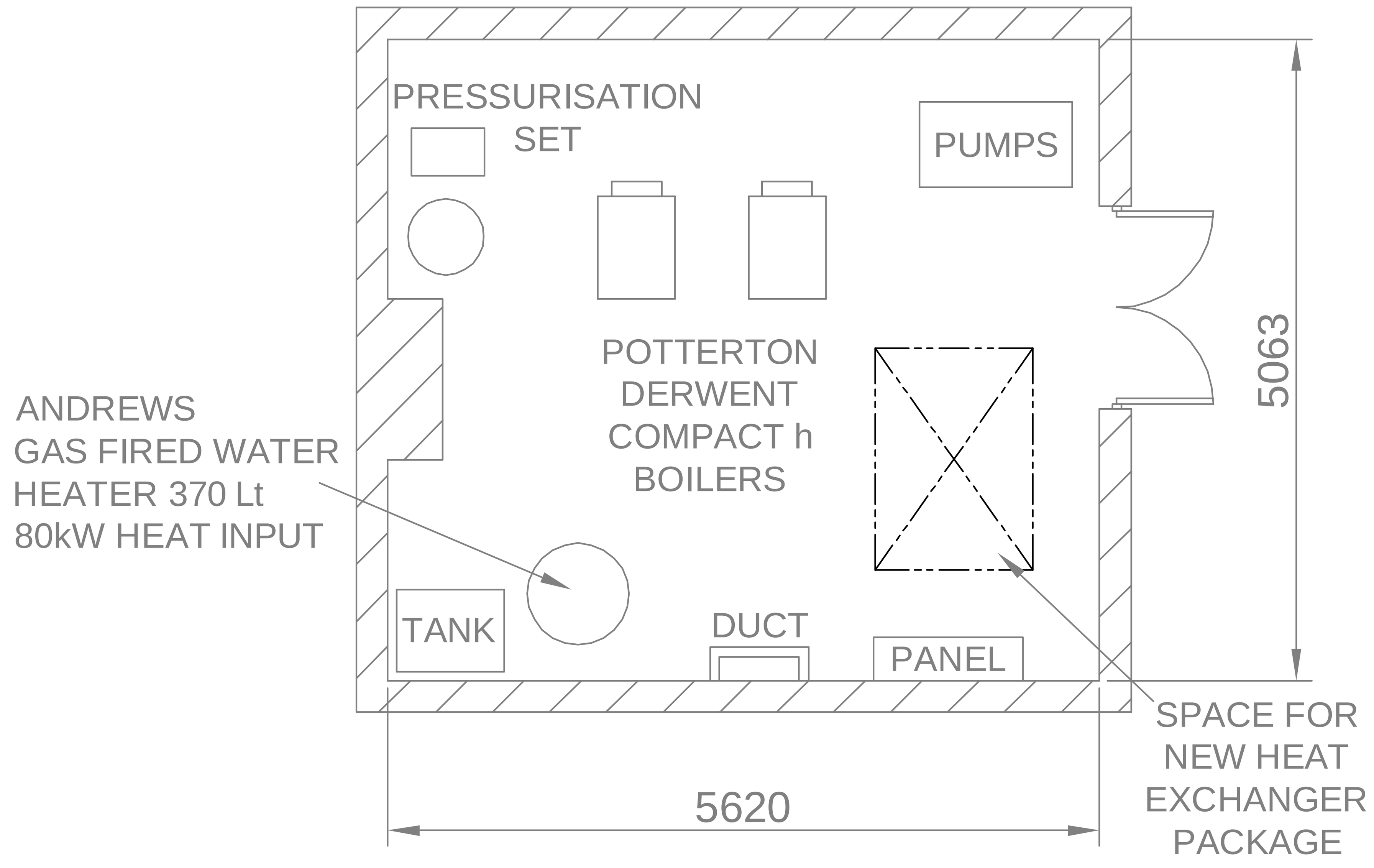
CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN

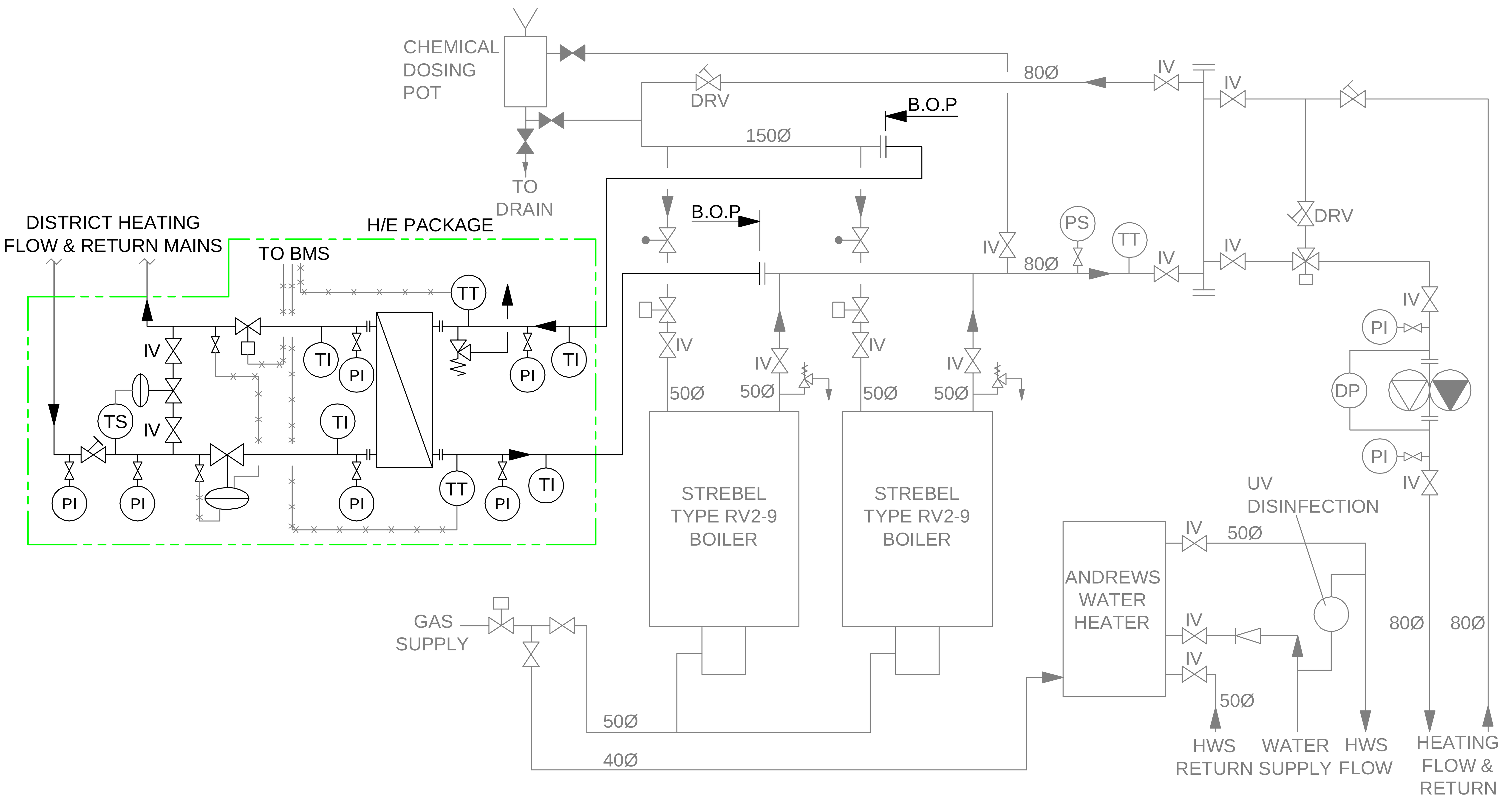
TITLE
LAYOUT OF DH CONNECTION TO 6TH FORM COLLEGE BOILER ROOM

DATE 13/04/12 — DRAWN BY RAYK
SCALE 1/100@A3 — PRODUCED BY
CAD REF — CHECKED RB
APPROVED RB

DRAWING NUMBER
3511559A-BEL-1-M015 A



BOILER ROOM PLAN



LEGEND

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REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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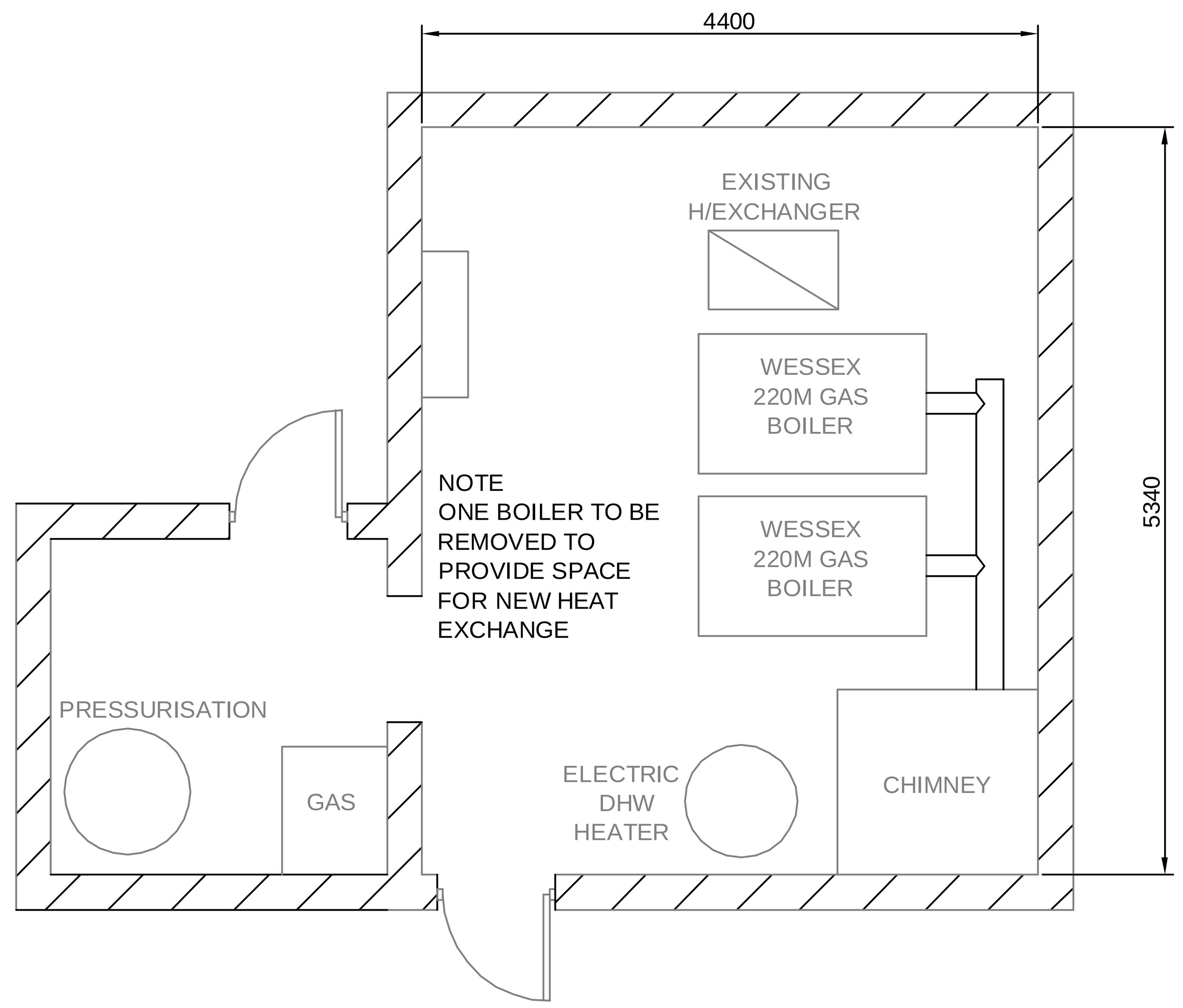
CLIENT/PROJECT
NORTH LONDON STRATEGIC ALLIANCE
UPPER LEE VALLEY DEN

TITLE
LAYOUT OF DH CONNECTION TO ST PAULS AND ALL HALLOWS BOILER ROOM

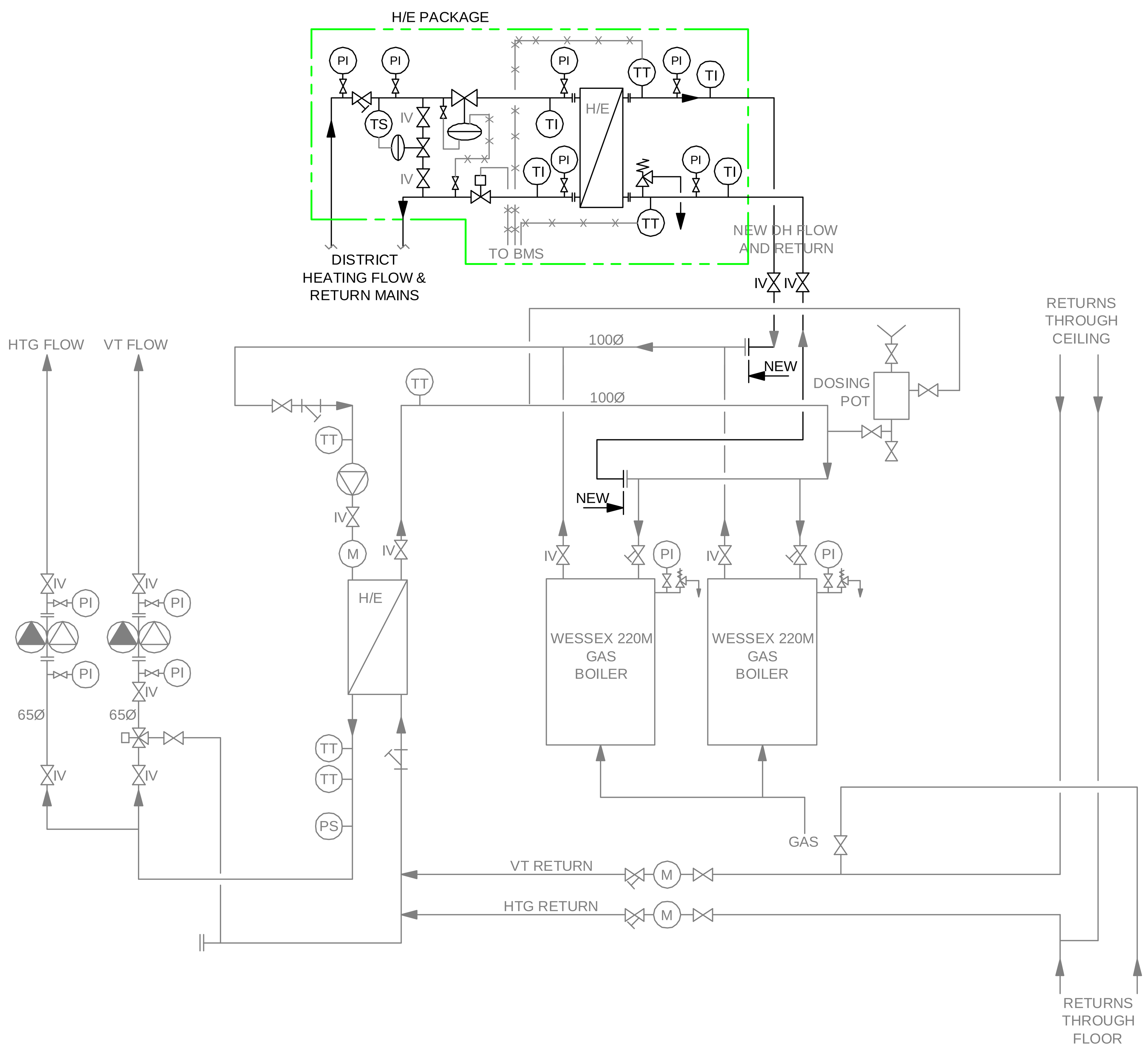
DATE 13/04/12
SCALE 1/75@A3
CAD REF

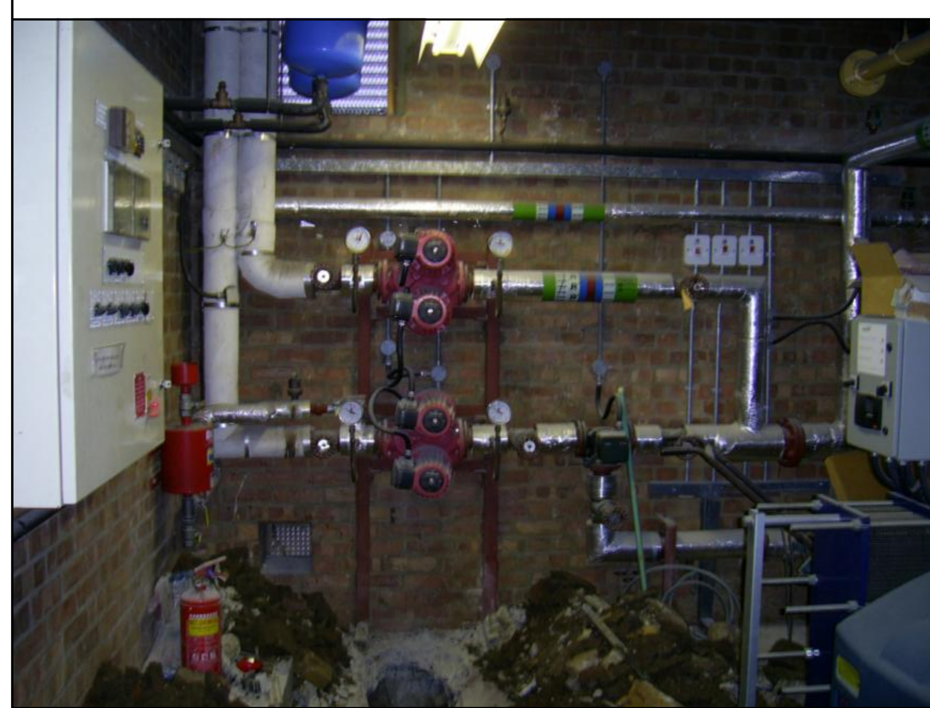
DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

DRAWING NUMBER
3511559A-BEL-1-M016 A



PLAN OF EXISTING PLANTROOM





LEGEND

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REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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- CLIENT/PROJECT
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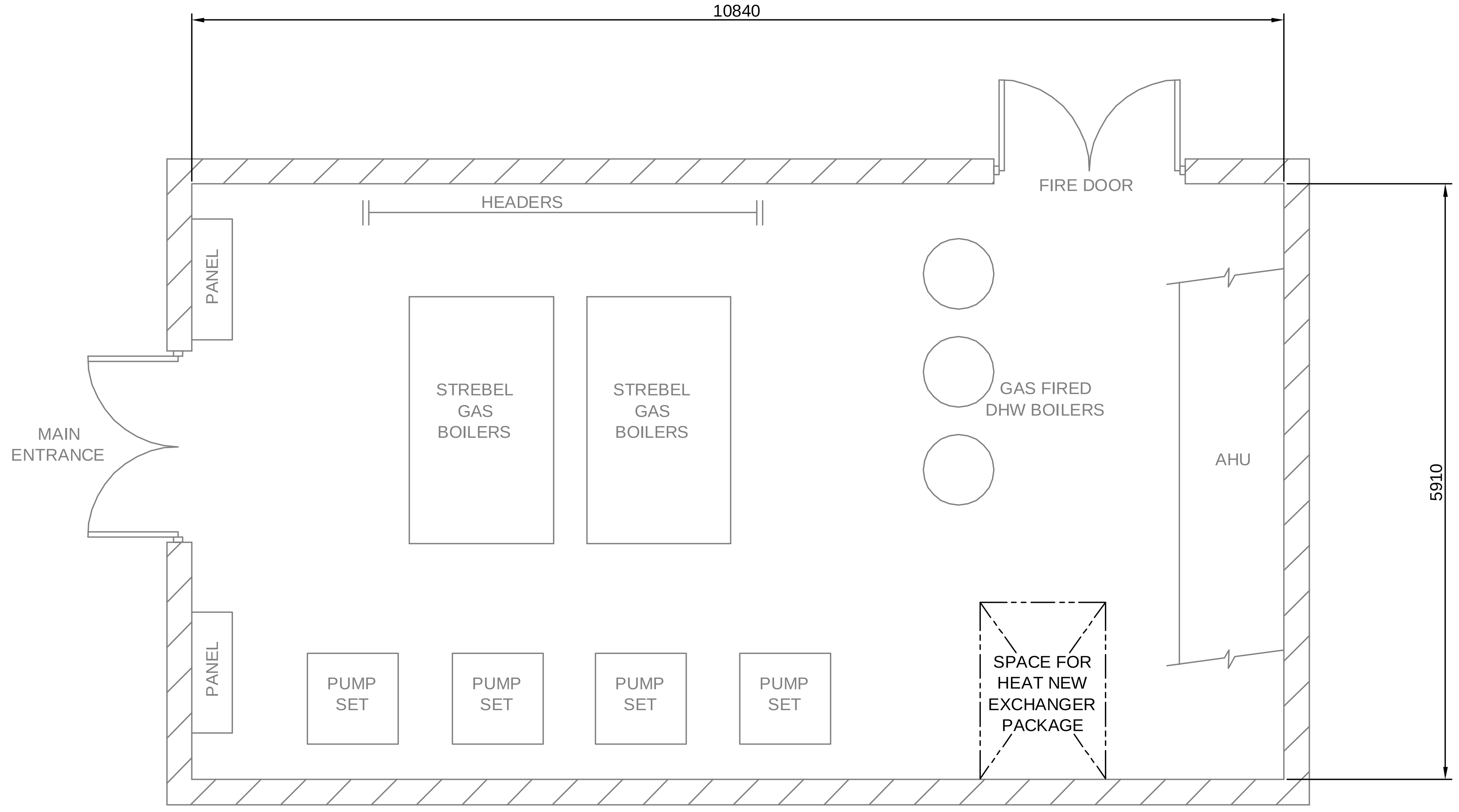
UPPER LEE VALLEY DEN
- TITLE
LAYOUT OF DH CONNECTION TO ST FRANCIS DE SALES RC JUNIOR SCHOOL PLANTROOM

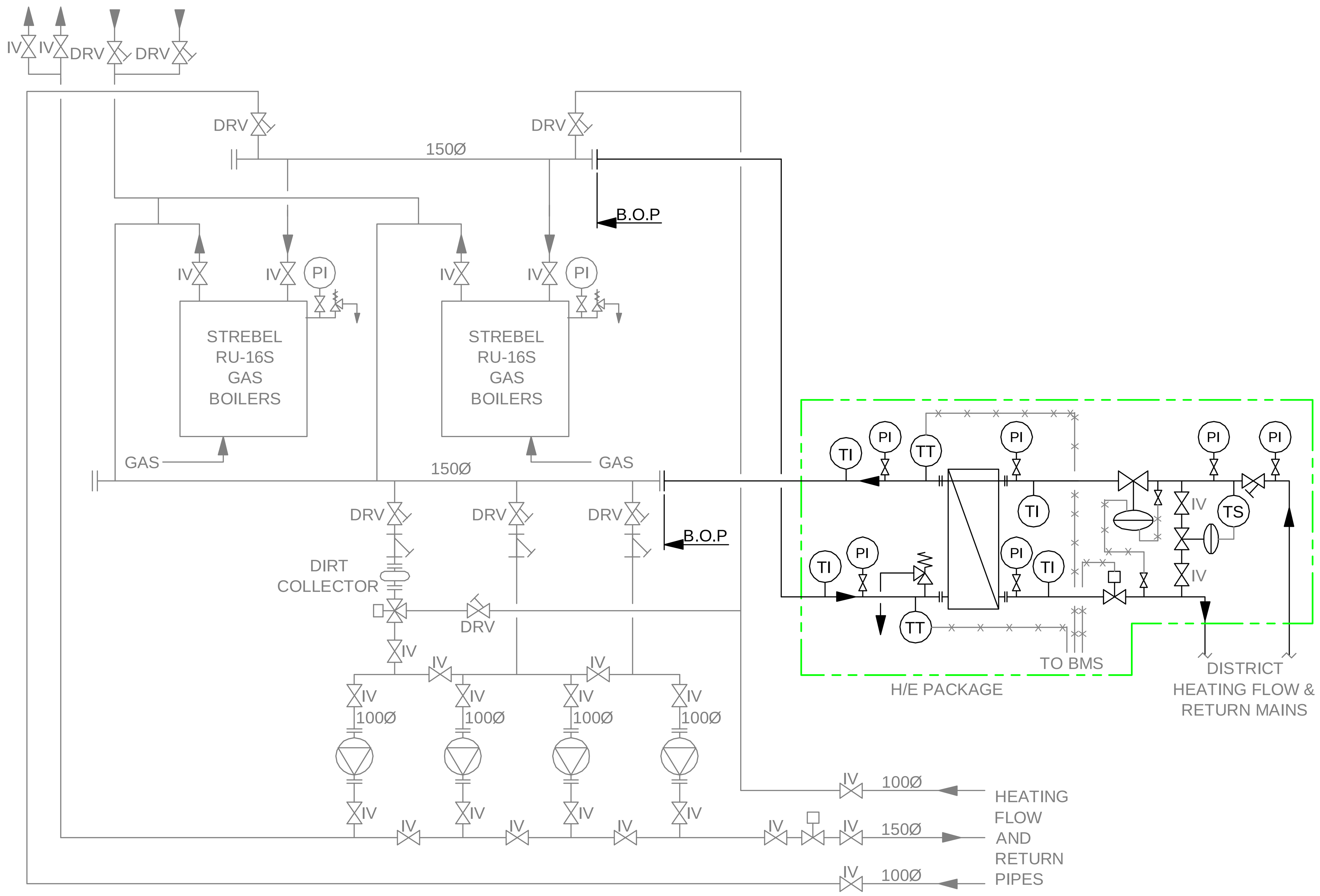
- DATE 09/03/12
- SCALE 1/75@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
3511559A-BEL-1-M005 A



PLAN OF EXISTING PLANTROOM



LEGEND

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REV.	DETAILS	DRN	CHK	APPR	DATE
A	ISSUED FOR COMMENT	RK	RB	RB	

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- CLIENT/PROJECT
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  UPPER LEE VALLEY DEN
- TITLE
  LAYOUT OF DH CONNECTION TO NORTHUMBERLAND PARK SCHOOL BOILER ROOM
- DATE 22/03/12
- SCALE 1/75@A3
- CAD REF

DRAWN BY RAYK
PRODUCED BY
CHECKED RB
APPROVED RB

- DRAWING NUMBER
  3511559A-BEL-1-M008 A