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MEP TECHNICAL NOTE

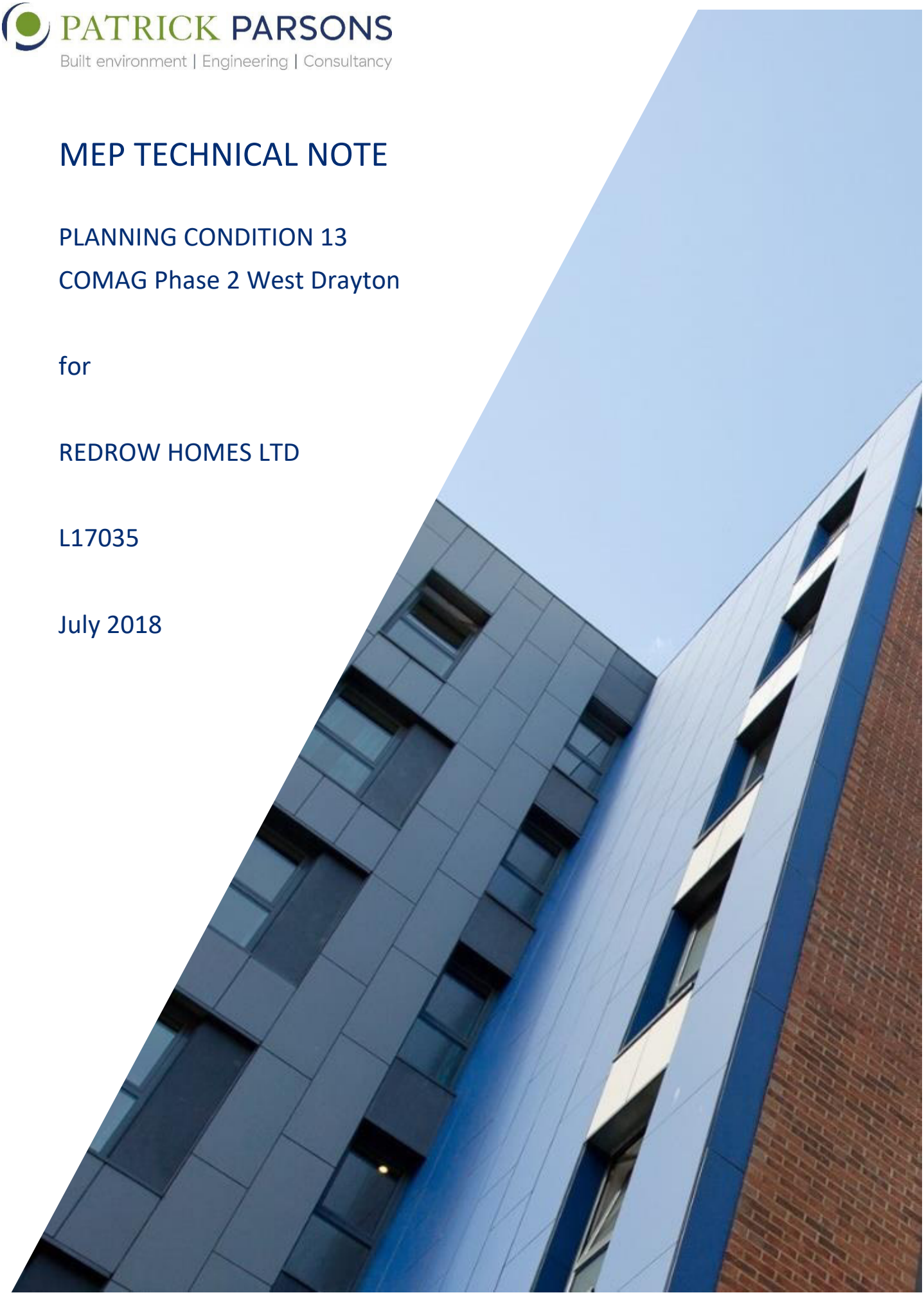
PLANNING CONDITION 13
COMAG Phase 2 West Drayton

for

REDROW HOMES LTD

L17035

July 2018



MEP TECHNICAL NOTE

PLANNING CONDITION 13

for

REDROW HOMES LTD

Revision	Date of issue	Comments	Prepared By	Checked By
P1	05/07/2018	Issued for Planning	AW	EB
P2	25/09/2018	Document revised following planning consultant comments	AW	EB

Should you have any queries relating to this document please contact:

Aled Williams BEng (Hons) LCEA LCC
Patrick Parsons Limited
Unit 5
St Johns Court
Vicars Lane
Chester, CH1 1QE

T: +44 (0) 1244 902000
E: a.williams@patrickparsons.co.uk

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1.0 Introduction

1.1 Technical Note

This technical note has been written to discharge planning condition 13 for the proposed Phase 2 residential development at the former COMAG building site, West Drayton. The development will comprise of 104 dwelling units, community space, amenity space with lift overrun and covered car parking.

2.0 Development Site

2.1 Existing Site Description

The development site is adjacent to Tavistock Road and Winnock Road, in West Drayton (see site location plan in Appendix A).

2.2 Proposed Site Description

As part of the works, the property will consist of 104 apartments between Ground – 6th floor split between two block, A and B. Access to the ground floor apartments is via Tavistock and Winnock Road. All apartments from 1st to 6th floor access is via the communal stairs and lifts within each block.

The 7th floor of block B shall include a break out amenity space which will also house the lift overrun. The total height of the building is 34.505m from basement slab Finish Floor Level (FFL) to the highest point above the lift overrun.

The ground level car park is situated adjacent to the cycle store. The basement level will include car parking and the addition of a central energy centre and electrical plant and metering room.

The energy centre shall house the central heating plant which shall consist of new Low Temperature Hot Water (LTHW) boilers and Combined Heat and Power (CHP) generation. A dedicated flue riser shall be provided allowing all combustible air to be discharged at high level above the 7th floor amenity space.

3.0 Planning Conditions and GLA Requirements

3.1 Planning Condition 13

- Prior to commencement (other than demolition) details of any plant, machinery and fuel burnt, as part of the energy provision and the location and height of the flue relative to the surrounding buildings and nearest openable windows at the development shall be submit-ted to the LPA for approval. This shall include pollutant emission rates at the flue with or without mitigation technologies.
- The use of ultra low NOx emission gas-fired CHPs and boilers is recommended.
- The development should as a minimum be 'air quality neutral' and demonstrably below the building emissions benchmark and as a minimum meet the GLA emission standards for a CHP.
- Prior to occupation of the development, the scheme shall be completed in strict accordance with the approved details and thereafter maintained for the life of the development.

3.2 The London Plan 2016 Policy 5:32

The Mayor supports the greater use of renewable and low carbon generation technologies and has set a target for London to generate 25 per cent of its heat and power requirements through the use of local, decentralised energy (DE) systems by 2025. DE generates power at point of use, making more efficient use of primary energy by utilising generated heat that would otherwise be wasted in large-scale thermal power generation plants. Supported by planned development, London's future district heating networks will evolve from natural gas CHP to being supplied by energy from waste. Depending on future technologies, the systems could mature into low temperature networks taking advantage of low grade surplus heat, minimising the need for primary energy input. Renewable energy DE opportunities including the use of energy from waste and biomass schemes are also supported. Shifting 25 per cent of London's energy demand to be supplied through decentralised systems could save up to 2.57 million tonnes of carbon dioxide a year. Greater use of DE will also help London become more self-sufficient and secure in relation to its energy needs.

3.3 The London Plan 2016 POLICY 5.6 DECENTRALISED ENERGY IN DEVELOPMENT PROPOSALS

Planning decisions

- Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.
- Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks;
2. Site wide CHP network;
3. Communal heating and cooling;

3.4 Sustainable Design and Construction Guide (SPG) Requirements.

Section 4.3.21 stipulates that:

Where individual and/or communal gas boilers are installed in commercial and domestic buildings they should achieve a NOx rating of <40 mgNOx/kWh. Guidance issued by DCLG[94] notes that individual gas boilers with NOx emissions lower than 40 mg/kWh are now standard for many developers and hence no extra cost is incurred.

Section 4.3.22 stipulates that:

Planning authorities have limited control over the plant installed in smaller developments, but most boroughs require new development to comply with Level 3 or 4 of the Code for Sustainable Homes or BREEAM 'very good' or 'excellent'. To encourage developments to make their contribution to air quality 'neutral' across London, boroughs may consider encouraging developers to obtain the maximum number of credits in the NOx emissions Issue (CfSH - Pol2 and BREEAM - Pol4). This equates to NOx emissions of no greater than 40 (mg/kWh) from heating plant.

Solid biomass and CHP plant

SPG outlines the Emissions Standards for Solid Biomass and CHP Plant. Emissions standards for CHP are categories into 2 bands which are define in Table 3.4.1 and 3.4.2.

Table 3.4.1: Emission Standards for Solid Biomass Boilers and CHP Plant in the Thermal Input range 50kWth – 20 MWth

Band	Applicable Range	
	Baseline Annual Mean NO2 and PM10	Baseline 24 Hour mean PM10
Band A	>5% below national objective	> 1-day less than national objective
Band B	Between 5% below or above national objective	1 day below or above national objective

Table 3.4.2: Emission Standards for Solid Biomass Boilers and CHP Plant in Thermal Input Range 50kWth to less than 20MWth for development in Band B

Combustion Appliance	Pollutant Parameter	Emission Standard at Reference O_2	Equivalent Concentration at 0% O_2 ($mgNm^{-3}$)	Likely Technique to Meet Emission Standard
Spark injection Enginer (natural gas/biogas)	NO_x	95	125	SCR (Lean Burn Engines NSCR (Rich burn Engines)

4.0 Proposal

4.1 Generation and Distribution Strategy

There are no existing heating or cooling district networks adjacent to the Tavistock Road site.

As part of the heating and distribution strategy, the development shall utilize Low NOx CHP and boilers. To maximize the operational energy production, the CHP shall be selected alongside a suitable buffer vessel and modulating boiler plant considering the following:

- To maximise the number of run hours to meet the thermal load of the building and maximizing the electrical contribution to the Smart Grid.
- Consider the available turndown ratio/ modulation of the CHP during reduced peak loads.
- Ensure the configuration of the CHP within the energy centre is optimized and therefore acting as the lead boiler.
- To ensure the development can contribute to future district heating scheme

Within the energy centre, there shall be a facility to integrate the phase 2 energy centre with future district heating developments. An area within the energy centre shall be allocated for the future installation of a plate heat exchanger and low loss header connections. This is turn, allows the new development to supply and benefit from any future planned district heating network works within the area.

The site shall be served by communal heating. Each apartment shall include a Heat Interface Unit (HIU) for the generation of heating and hot water.

4.2 Plant Selection

CHP Selection

It is proposed that the CHP for the COMAG Phase 2 development shall be an ENRGY Low NO_x 70M CHP. The CHP shall be fitted with the additional low NOx catalytic converter. Full technical datasheet can be found in Appendix D

Selected CHP Plant NO_x emission = <50mg/Nm^3 at 5% O_2

Selected CHP Plant NO_x emission = 50 x cf

Cf = 1.4 based on BREEAM 2016 Pol02 Dry NO_x level

Selected CHP Plant NO_x emission = <70mg/Nm^3 at 0% O_2

Boiler Selection

It is proposed that the boilers for the COMAG Phase 2 development shall be 2no. Hamworthy Wessex Modumax MK3 97/291V. Full technical datasheet can be found in Appendix C

Selected boiler plant NO_x emission = 39.8mg/kWh

4.3 Emissions

4.3.1 Air Quality Assessment.

The following table 4.3.1 outlines the NOx Emissions of the CHP and boilers from the air quality assessment that those selected for the proposed site. Full emission parameters for combustion sources for the air quality assessment can be found in Appendix X.

Table 4.3.1: Air Quality Assessment and Proposed Plant

Parameter	Air Quality Assessment CHP data	Energy E70 low NOx CHP	Air Quality Assessment Boiler Data	Wessex Modumax MK3 97
Stack Height (m)	27.78	36	27.78	36
Stack Diameter (m)	0.1	0.1 (ID)	0.15	0.25 (ID)
NOx Emission (mg/Nm^3)	50	<70 With Catalyst	37.3	39.8

4.3.2 Flue Calculations and D1 Clean Air Act Compliance

The boiler and CHP plant shall be served by separate flue systems. See appendix E for Boiler and CHP flue calculation.

Both flues shall be located internally, distributing to roof level within a fire rated riser within Block B. Inspection doors shall be located on each riser to ensure the flue condition can be inspected following post completion. The flue shall be discharge at roof level above the amenity space. Based on the clean air act calculations that flues must terminate 8.5m horizontally away from a building structural inline with the flue termination point and 3m above roof FFL. See appendix E for D1 Clean Air Act Calculation.

4.3.3 Flue Location and Proximity

- Flue Location: Block B amenity space
- Flue Height: 3m minimum above FFL Roof Level (see Appendix E Clean air act calculation)
- Flue clearance perimeter: 8.5m (see Appendix E Clean air act calculation)
- Flue distance from nearest adjacent building: 23.679m (Tavis Stock Phase 1)
- Flue distance from nearest structural: 5.493m (Lift overrun)

Lift overrun area: $15.8m^2$
Roof area: $840m^2$
Lift overrun percentage floor area of roof: 1.88%
Greater at 1%: Yes

- Proposed flue final termination height: 5.250m above roof FFL (1m above lift overrun)
- Flue distance from nearest window opening: 9.161m

4.3.4 Plant and Equipment Life Cycle

To ensure effective running of the proposed plant for the duration of the development, a planned maintenance agreement shall be utilized to ensure sufficient maintenance is undertaken over the duration of the plant life expectancy. CIBSE Guide M: Maintenance

Engineering and Management stipulate that indicative life expectancy of modular boilers and CHP plant

Boiler Plant:

- *Modular boilers - 15 Years*

Power generation:

- *Combined heat and power (CHP) (gas fired) – 20 years*

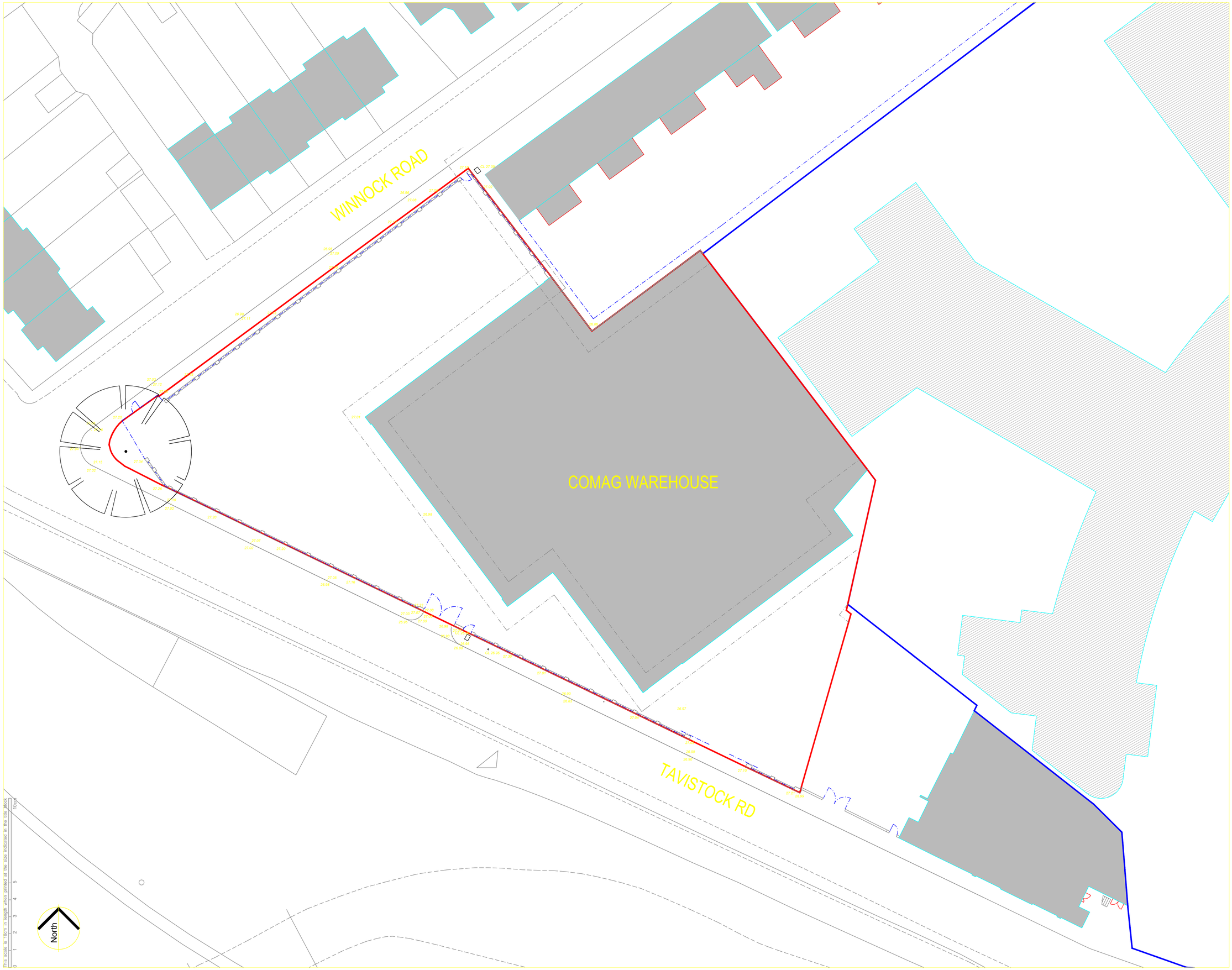
4.3.5 Maintenance Coverage

Mechanical plant shall be maintained in accordance with the manufactures recommendations. The maintenance contract for the CHP plant shall ensure that the following components are covered under the policy:

- Engine Inspection
- Spark Plug inspection and replacement
- Gas Tightness testing
- Re-calibrations
- Air/Oil Filter Replacement
- Ignition calibration
- Valve setting and Measurements
- Cleaning of Unit Interior and Exterior
- Replace Rocker Covers
- Drain and Flush of Water Systems
- Monitoring of System Pressure
- Battery Conditions Checks
- Lube Oil Replacement.

Appendix A

SITE LOCATION PLAN



NOTES

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1 The Contractor must check and confirm all dimensions

2 All discrepancies must be reported and resolved by the Architect before works commence

3 This drawing is not to be scaled

4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards

This scale is 10cm in length when printed at the size indicated in the title block. 10cm 0 1 2 3 4 5

Rev	Date
1D Issued for Planning	17/11/17
1C Issued for Planning	30/10/17
1B Issued for Planning	18/08/17
1A Issued for Planning	11/08/17

Rolfe Judd
Architecture Planning Interiors
Old Church Court, Claylands Road, The Oval, London SW8 1NZ
T 020 7556 1500
www.rolfe-judd.co.uk

Client
Redrow Homes Ltd (London)

Project
Padcroft Phase II

Drawing
As Existing
Site Layout

Scale	Date	Status
1:200 (A1)	Aug 17	Planning

Job Number	Drawing Number	Revision
5935	T(10)P00	1D

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NOTES

1 The Contractor must check and confirm all dimensions
2 All discrepancies must be reported and resolved by the Architect before works commence
3 This drawing is not to be scaled
4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards

WINNOCK ROAD
TAVISTOCK RD
ACCESS FROM PAVEMENT
SUB-STATION
MAIN WATER
PRIVATE AMENITY SPACE
SHARED AMENITY SPACE
SHARED AMENITY SPACE
BLDG - A
REFUSE A
VISITOR
POST
PARKING
MOTORCYCLES
RAMP DOWN
RAMP UP
CYCLES
BLDG - B
REFUSE B
MEETING ROOM
TOILETS
COMMUNITY SPACE
POTENTIAL PHASE 3
INDICATIVE FOOTPRINT
76 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95
96 97 98 99 100 101 102 103 103
North
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0 1 2 3 4 5 10cm

Rev		Date
1E	Issued for Planning	19/01/18
1D	Issued for Planning	17/11/17
1C	Issued for Planning	30/10/17
1B	Issued for Planning	18/08/17
1A	Issued for Planning	11/08/17

Rolfe Judd
Architecture Planning Interiors
Old Church Court, Claylands Road, The Oval, London SW8 1NZ
T 020 7556 1500
www.rolfe-judd.co.uk

Client
Redrow Homes Ltd (London)

Project
Padcroft Phase II

Drawing
As Proposed
Ground Floor Plan

Scale	Date	Status
1:200 (A1)	Aug 17	Planning

Job Number	Drawing Number	Revision
5935	T(20)P00	1E

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Appendix B

SITE ELEVATIONS

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NOTES

1 The Contractor must check and confirm all dimensions
2 All discrepancies must be reported and resolved by the Architect before works commence
3 This drawing is not to be scaled
4 All work and materials to be in accordance with current applicable Statutory Legislation and to comply with all relevant Codes of Practice and British Standards



1 - Proposed Elevation 3
SCALE: 1:200 (A1)

SOUTH ELEVATION SHOWN ON Z20S02



2 - Proposed Elevation 4
SCALE: 1:200 (A1)





3 - Proposed Elevation 5
SCALE: 1:200 (A1)

This scale is 10cm in length when printed at the size indicated in the title block
0 1 2 3 4 5 10cm

Rev		Date
1E	Issued for Planning	19/01/18
1D	Issued for Planning	17/11/17
1C	Issued for Planning	27/10/17
1B	Issued for Planning	18/08/17
1A	Issued for Planning	11/08/17

Rolfe Judd
Architecture Planning Interiors
Old Church Court, Claylands Road, The Oval, London SW8 1NZ
T 020 7556 1500
www.rolfe-judd.co.uk

Client
Redrow Homes Ltd (London)

Project
Padcroft Phase II

Drawing
Proposed Elevations 3, 4 & 5

Scale	Date	Status
1:200 (A1)	Aug 17	Planning

Job Number	Drawing Number	Revision
5935	T(20)E02	1E

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Appendix C

BOILER PLANT TECHNICAL SUBMISSION

6 MODELS

97-348 kW OUTPUT

Wessex ModuMax mk3 technical data

Models WM97/97H, WM 97/194V, WM97/291V, WM116/116H, WM116/232V, WM116/348V

97 and **116kW** modules

	Wessex ModuMax mk3 boiler model	Units	97/97H	97/194V	97/291V	116/116H	116/232V	116/348V
	No. of modules		1	2	3	1	2	3
Energy	Building regulations Part L seasonal efficiency	% gross	94.98	94.98	94.98	93.19	93.19	93.19
	Boiler output 80/60°C, NG & LPG	kW	95.7	191.4	287.1	115.2	230.4	345.6
	Boiler output 50/30°C, NG & LPG	kW	97.2	194.4	291.6	116.2	232.5	348.7
	Boiler input (gross) - maximum, NG	kW	109	218	327	133	266	399
	Boiler input (gross) - maximum, LPG	kW	106.7	213.4	320.1	130.2	260.4	390.5
	Boiler input (net) - maximum, NG & LPG	kW	98.2	196.4	294.6	119.8	239.6	359.4
	Boiler output - minimum 80/60°C, NG & LPG	kW	19.1	19.1	19.1	23.5	23.5	23.5
Water	Water content	litres	16	32	48	16	32	48
	System design flow rate @ 40°C ΔT rise	l/s	0.6	1.2	1.8	0.7	1.4	2.1
	Water side pressure loss @ 40°C ΔT rise	mbar	5	5	5	7	7	7
	System design flow rate @ 30°C ΔT rise	l/s	0.8	1.6	2.4	1	2	3
	Water side pressure loss @ 30°C ΔT rise	mbar	9	9	9	14	14	14
	System design flow rate @ 20°C ΔT rise	l/s	1.2	2.4	3.6	1.4	2.8	4.2
	Water side pressure loss @ 20°C ΔT rise	mbar	20	20	20	27	27	27
	System design flow rate @ 11°C ΔT rise	l/s	2.2	4.4	6.6	2.6	5.2	7.8
	Water side pressure loss @ 11°C ΔT rise	mbar	61	61	61	91	91	91
	Minimum water pressure	barg	Dependent on differential temperature – see page 25 in full brochure					
	Maximum water pressure	barg	10	10	10	10	10	10
	Maximum flow temperature setting	°C	90	90	90	90	90	90
Gas	Gas flow rate, NG (G20) - maximum	m³/hr	10.8	21.6	32.4	12.7	25.4	38.1
	Gas flow rate, LPG (G31) - maximum	m³/hr	4	8	12	5	10	15
	Nominal inlet pressure, NG (LPG) - maximum	mbar	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)
	Maximum gas inlet pressure NG (LPG)	mbar	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)
Flue	Approx. flue gas volume @ 15°C, 8.75-9.25% CO_2	m³/hr	143	286	429	160	320	480
	Maximum flue gas temperature @ 80/60°C	°C	83	83	83	83	83	83
	Pressure at boiler flue connection	Pa mbar	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5
	Dry NOx emission (0% excess oxygen, dry air free) - NG	mg/kWh	39.8	39.8	39.8	34.3	34.3	34.3
	Dry NOx emission (0% excess oxygen, dry air free) - LPG	mg/kWh	42	42	42	57.3	57.3	57.3
Connection	Water flow/return connections	inches	G1½" male	G1½" male	G1½" male	G1½" male	G1½" male	G1½" male
	Gas inlet connection pipe thread size	inches	R1" male	R1" male	R1" male	R1" male	R1" male	R1" male
	Nominal flue diameter (I/D)	mm	100	180	180	100	180	180
	Condensate trap connection(s) (O/D)	mm	32	32	32	32	32	32
Electrics	Electrical supply		230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz
	Power consumption - maximum boiler modulation	W	166	332	498	166	332	498
	Start current (per module)	Amp	1.2	1.2	1.2	1.2	1.2	1.2
	Run current (per module)	Amp	0.72	0.72	0.72	0.72	0.72	0.72
	Approx shipping weight	kg	180	355	540	180	355	540
	Noise emission @1m @maximum modulation	Max dB (A)	60	60	60	60	60	60
	Noise emission @1m @minimum modulation	Min dB (A)	47	47	47	47	47	47

9 MODELS

147-762 kW OUTPUT

Wessex ModuMax mk3 technical data

Models WM147/147H, WM147/294V, WM147/441V, WM196/196H, WM196/392V, WM196/588V, WM254/254H, WM254/508V, WM258/762V

147, 196 and **254kW** modules

	Wessex ModuMax mk3 boiler model	Units	147/147H	147/294V	147/441V	196/196H	196/392V	196/588V	254/254H	254/508V	254/762V
	No. of modules		1	2	3	1	2	3	1	2	3
Energy	Building regulations Part L seasonal efficiency	% gross	94.76	94.76	94.76	94.98	94.98	94.98	93.19	93.19	93.19
	Boiler output 80/60°C, NG & LPG	kW	142.8	285.6	428.4	191.6	383.2	574.8	239.8	479.6	719.4
	Boiler output 50/30°C, NG & LPG	kW	147.4	294.8	442.2	196.3	392.6	588.9	254.4	508.7	763.1
	Boiler input (gross) - maximum, NG	kW	163	326	489	219	428.7	657	275	550	825
	Boiler input (gross) - maximum, LPG	kW	159.5	319.1	478.6	214.4	428.7	643.1	269.2	538.3	807.5
	Boiler input (nett) - maximum, NG & LPG	kW	146.8	293.6	440.3	197.2	394.4	591.6	247.6	495.3	742.9
	Boiler output - minimum 80/60°C, NG & LPG	kW	28.7	28.7	28.7	38.6	38.6	38.6	48.4	48.4	48.4
Water	Water content	litres	22	44	66	22	44	66	22	44	66
	System design flow rate @ 40°C ΔT rise	l/s	0.9	1.8	2.7	1.2	2.4	3.6	1.5	3	4.5
	Water side pressure loss @ 40°C ΔT rise	mbar	36	36	36	62	62	62	100	100	100
	System design flow rate @ 30°C ΔT rise	l/s	1.2	2.4	3.6	1.6	3.2	4.8	2	4	6
	Water side pressure loss @ 30°C ΔT rise	mbar	60	60	60	120	120	120	180	180	180
	System design flow rate @ 20°C ΔT rise	l/s	1.8	3.6	5.4	2.4	4.8	7.2	3	6	9
	Water side pressure loss @ 20°C ΔT rise	mbar	145	145	145	246	246	246	395	395	395
	System design flow rate @ 11°C ΔT rise	l/s	3.3	6.6	9.9	4.3	8.6	12.9	5.4	10.8	16.2
	Water side pressure loss @ 11°C ΔT rise	mbar	500	500	500	850	850	850	1300	1300	1300
	Minimum water pressure	barg	Dependent on differential temperature – see page 25 in full brochure								
	Maximum water pressure	barg	10	10	10	10	10	10	10	10	10
	Maximum flow temperature setting	°C	90	90	90	90	90	90	90	90	90
Gas	Gas flow rate, NG (G20) - maximum	m^3/hr	16	32	48	21.4	42.8	64.2	27.9	55.8	83.7
	Gas flow rate, LPG (G31) - maximum	m^3/hr	6	12	18	8.1	16.2	24.3	10.1	20.2	30.3
	Nominal inlet pressure, NG (LPG) - maximum	mbar	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)	20 (37)
	Maximum gas inlet pressure NG (LPG)	mbar	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)	25 (45)
Flue	Approx. flue gas volume @ 15°C, 8.75-9.25% CO_2	m^3/hr	214	428	642	279	558	837	354	708	1062
	Maximum flue gas temperature @ 80/60°C	°C	78	78	78	83	83	83	82	82	82
	Pressure at boiler flue connection	Pa mbar	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5	150 1.5
	Dry NOx emission (0% excess oxygen, dry air free) - NG	mg/kWh	37.7	37.7	37.7	39.9	39.9	39.9	38.8	38.8	38.8
	Dry NOx emission (0% excess oxygen, dry air free) - LPG	mg/kWh	69.3	69.3	69.3	68.6	68.6	68.6	39.9	39.9	39.9
Connection	Water flow/return connections	inches	G2½" male	G2½" male	G2½" male	G2½" male	G2½" male	G2½" male	G2½" male	G2½" male	G2½" male
	Gas inlet connection pipe thread size	inches	R1¼" male	R1¼" male	R1¼" male	R1¼" male	R1¼" male	R1¼" male	R1¼" male	R1¼" male	R1¼" male
	Nominal flue diameter (I/D)	mm	150	250	250	150	250	250	150	250	250
	Condensate trap connection(s) (O/D)	mm	32	32	32	32	32	32	32	32	32
Electrics	Electrical supply		230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz	230V 1Ph 50Hz
	Power consumption - maximum boiler modulation	W	240	480	720	240	480	720	240	480	720
	Start current (per module)	Amp	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	Run current (per module)	Amp	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
	Approx shipping weight	kg	226	452	678	226	452	678	226	452	678
	Noise emission @1m @maximum modulation	Max dB (A)	65	65	65	65	65	65	65	65	65
	Noise emission @1m @minimum modulation	Min dB (A)	47	47	47	47	47	47	47	47	47

Appendix D

CHP PLANT TECHNICAL SUBMISSION

Technical Datasheet

E70M (Low NOx) Natural Gas CHP Unit

Energy Balance and Load Data at Power Factor 1		Units	100%	75%***	50%***
Electrical Output	(+/-3%)	kW	71	53	35
Electrical Efficiency (Net)	(+/-5%)	%	34.7%	33.4%	29.0%
Heat Output	(+/-10%)	kW	109	85	66
Thermal Efficiency (Net)	(+/-8%)	%	53.4%	53.5%	54.1%
Fuel Input (Net / Gross)*	(+/-5%)	kW	204 / 226	159 / 176	122 / 135
Total Efficiency (Net)	(+/-8%)	%	88.2%	86.9%	83.1%
Heat Output from Jacket Water	(+/-7%)	kW	63	52	43
Heat Output from Exhaust Gas @ Outlet Temp.	(+/-7%)	kW	46	33	23
Aftercooler Heat Output	(+/-7%)	kW	N/A	N/A	N/A
Radiated Heat Output	(+/-7%)	kW	15	11	8
Combustion Air Flow (30 °C, 100 kPa, 30% RH)**	(+/-5%)	m^3/h	221	170	130
Fuel Mass Flow (ρ = 0.75kg/Nm³)	(+/-5%)	kg/h	15.3	11.9	9.2
Fuel Volume Flow (LHV = 10kWh/Nm³)	(+/-5%)	Nm3/h	20.4	15.9	12.2
Exhaust Mass Flow (Wet)	(+/-5%)	kg/h	272	209	160
Exhaust Volume Flow @ Outlet Temp.	(+/-5%)	m^3/h	303	233	178

*Natural gas Net and Gross fuel input figures are based on 36MJ/Nm3 and 39.8MJ/Nm3 respectively. The Gross figure is used when establishing UK fuel costs. Net figures are provided for ease of performance comparison with other technologies. Fuel must comply with engine manufacturer's fuel quality guide, supplied seperately.

**Engine technical data is based on Standard Conditions according to DIN ISO 3046-1 but engine de-rate applies when Combustion Air Temperature is >25°C.

*** If operating at part load for long periods of time, the unit should be run at full load for at least 5 hours in a given 24 hour period.

Engine Details

Manufacturer	MAN
Model	E 0836 E 302
Fuel Type	Natural Gas
Min. Methane Number	80
Cylinders	6
Aspiration	Natural
Speed rpm	1500
Aftercooler	No

Hot Water Details

Max. Water In/Out Temp. °C	80/90°C
Max. Water Flow Rate* l/s	2.68
Max. Glycol Content %	30
Connection Size mm	50
Flange Type	PN16
Pressure Loss** kPa	17.2
Max. Test Pressure Bar	9.75

* Assuming Cp = 4.2 kJ/kg·K and ρ = 968.55 kg/m³

** Pressure loss figures stated are at max. water flow rate. Internal unit only.

Exhaust Details

Connection Size mm	100
Flange Type	PN6
Outlet Temp***. °C	120
Allowable Backpressure Pa	1870
Allowable Backpressure with Catalyst... Pa	1510

*** For engines with exhaust bypass, please request exhaust bypass temp. from ECPL.

Ventilation Details

Connection Size mm	500
Ventilation Rate**** m^3/s	1.55
Max. Air Inlet Temp. °C	30
Max. Air Outlet Temp. °C	45
Enclosure Pressure Drop Pa	111

**** Vent rate is stated at max. air outlet temp, 100kPa

Generator Details

Manufacturer		Stamford
Model		UCI274E-311
Type		Synchronous
Rating	kVA	140
Voltage	V	400
Phase	Ph	3
Frequency	Hz	50
Protection Class		IP23
Rated Power Factor	PF	0.8
Xd Dir. Axis Synchronous		2.11
X'd Dir. Axis Transient		0.19
X"d Dir. Axis Sub-Transient		0.13
T" Sub-Transient Time Const.		0.01
T'do O.C Field Time Const.		0.85
CHP Protection Device	A/Ph	140
Indicative Client Protection Device	A/Ph	125 (Adjustable)
Current Per Phase @ 0.8PF	A	126
Current Per Phase @ 0.95PF	A	107
Efficiency @ 0.8PF	%	92.8%
Efficiency @ 0.95PF	%	94.1%
Indicative Main Cable Size [a] †	mm^2	TBC
Indicative Earth Cable Size [b] †	mm^2	TBC

[a] 4-Core XLPE/SWA/PVC to BS5467, Max 50 meters.

[b] 1-Core 6491B to BS7211, Max 50 meters.

† Sizes and lengths based on IET 17TH Edition BS7671, Installation method 31.

Fuel Details

Connection Size	mm	40
Flange Type		PN16
Min/Max. Supply Pressure	mbar	20/45

Emissions @ 5% O2

NOx	mg/Nm^3	7000
CO	mg/Nm^3	5000
NOx (With Catalyst)	mg/Nm^3	<50
CO (With Catalyst)	mg/Nm^3	<150

Weight Details

Enclosure (Dry) STD/PREM.	See Sales Drawing
Container (Dry) STD/PREM.	See Sales Drawing

Noise Data

Enclosure SPL @ 1m SN/LN	dB(A)	70/64.7
Container SPL @ 1m SN/LN	dB(A)	75/65

NB: Output figures are based on operation at DIN ISO 3046-1 conditions with the exception of exhaust output, which is quoted to 120°C/180°C for Natural Gas/Biogas respectively, figures are stated from manufacturer's declared performance figures subject to the manufacturer's tolerances and subject to change without notice. Values for de-rated units are estimates only. Energy balance data assumes perfect combustion. All information detailed is for guidance only and is subject to change without notice due to our commitment to continuous improvement - all values should be confirmed with ENER-G Combined Power Ltd on a project specific basis.

Appendix E

CLEAN AIR ACT CALCULATION

Jeremias UK Ltd
Unit 2-4 Long Stoop Way, Crown Farm Industrial Estate
Mansfield, Nottinghamshire, NG22 0FQ
Tel: 01623 889219
sales@jeremias.uk
www.jeremias.uk

Calculation of Chimneys according to EN 13384-2

Date	04/07/2018

Design of Plant - Multiple Appliances

Number of Chimney Entries	1
...at Chimney Entry 1	2 Appliances
Chimney	House Chimney
Position/Run	Inside Building
Fresh Air Supply	Dependent on Room Air
Air Supplied by	From Installaion Room
Sections	Connector: 1, Chimney: 1
Outlet	Open Outlet Zeta = 0



Environment

Geodetic Height	50 m	
Safety Factor SE	1.2	
Correction Factor SH	0.5	
Ambient Air Temperatures (Standards)		
At top Outlet	-15 °C	(Temperature Requirement)
Outside Area	-15 °C	(Temperature Requirement)
In Unheated Areas	0 °C	(Temperature Requirement)
In Heated Areas	20 °C	(Temperature Requirement)
Ambient Air	15 °C	(Pressure Requirement)

Appliances 1 and 2

Category	Gas Condensing Appliance
Manufacturer, Model	Hamworthy Wessex Modumax Mk3 97/291v
Fuel	Natural Gas

	High Fire	Low Fire
Nominal Output (Net)	291 kW	20 kW
Nominal Output (Gross)	329.86 kW	23.38 kW
CO2 Level	9 %	9 %
Mass Flow	145.28 g/s	10.97 g/s
Temperature	83 °C	56 °C
Maximum Feed Pressure	110 Pa	110 Pa
Appliance Outlet	Round 180 mm	
Required Air (Factor Beta)	0.9	
Non-Return Valve	Part of Appliance	

Installation Room for Appliances 1 and 2

Category	Installation Room
Fresh Air	Windows, Opening from Outside
Extract Air	None

Connector Section 3 - Construction

Category	Connector		
Cross Section	Round 250 mm		
Layers	Material	Thickness	Thermal Cond.
	Stainless Steel	0.6 mm	17 W/mK
Rugosity	1 mm		
Product Classification	T200 P1 W V2 O		

Connector Sections 1 and 2 - Construction

Category	Connector		
Cross Section	Round 180 mm		
Layers	Material	Thickness	Thermal Cond.
	Stainless Steel	0.6 mm	17 W/mK
Rugosity	1 mm		
Product Classification	T200 P1 W V2 O		

Connector Section 3 - Geometrie

Resistances	None
Effective Height	0 m
Drawn Lenght	1.4 m
Portion in outside areas	0 %
Portion in unheated areas	0 %
Portion in heated areas	100 %

Connector Section 2 - Geometrie

Resistances	Segment Bend (3) 87 °
Effective Height	0.5 m
Drawn Lenght	1.3 m
Portion in outside areas	0 %
Portion in unheated areas	0 %
Portion in heated areas	100 %

Connector Section 1 - Geometrie

Resistances	Segment Bend (3) 87 °
Effective Height	0.5 m
Drawn Lenght	2 m
Portion in outside areas	0 %
Portion in unheated areas	0 %
Portion in heated areas	100 %

Chimney - Construction

Category	Single Wall Chimney
Cross Section	Round 250 mm
Thermal Resistance	0 m²K/W
Thickness	1 mm
Inner Wall Material	Stainless Steel
Rugosity	1 mm
Product Classification	T200 P1 W O
Chimney Classification	EN 15287 - T200 P1 W 2 O (R0.00)

Chimney - Geometrie

Resistances	None
Effective Height	33 m
Drawn Lenght	33 m

Chimney - Course (Inside Building)

Portion in outside areas	0 %
Portion in unheated areas	0 %
Portion in heated areas	100 %
Building Contact	All Sides
Additional Insulation	
Outside Area	canceled
In Unheated Areas	canceled

Outlet Resistance

Outlet Resistance	Open Outlet
Zeta	0

Entry 2

Resistance	Tee 45 °

Entry 1

Resistance	Tee 87 °

Additional Results

Outlet Cross Section	490.9 cm²	
E'flux	5.6 m/s	
Flue Gas Density	1.057 kg/m³	
Flow Noise	29.3 dB(A)	
Max. Downwash	Wind Velocity	
At TL = -15 °C	13.97 m/s	
At TL = +15 °C	15.6 m/s	
Theoretical Draught	49.1 Pa	
Flue Gas Density	0.956 kg/m³	
Velocity	6.19 m/s	
Maximum Draught	67.4 Pa	(Negative Pressure At Flow Separation)

Layer Temperatures

Temperatures at the outside surface of the respective layer nearby the inlet.

Section 1		
Flue Gas		77 °C
Inner Wall		39 °C
Wall (R00)	1 mm	39 °C
Ambient Air		20 °C

Total Result

Mode	Planned With Positive Pressure, Wet

Appliance:	**1**	**2**
All appl. at nom. Output (a)	**+++**	**+++**
All appl. at min. Output (b)	**+++**	**+++**
Only one Appl. At Nom. Output (c)	**+++**	
Only one Appl. At Min. Output (d)	**+++**	
Reflux at Nom. Output	**+**	**+**

Chimney:	
Temperature Requirement	**-**

Not all of the mentioned conditions for the check of the function of the chimney are fulfilled. The plant does not fit all conditions of standard EN 13384-2.

Detailed Results - Pressure Requirements (Mass Flows)

Pressure Requirement (a) All heating appliances are simultaneously in operation with maximum thermal input (nom. output).

Mass Flow (g/s)	mw_c	mw	mw_c - mw	
Appliance 2	145.3	145.3	0	**+++**
Appliance 1	145.3	145.3	0	**+++**

Pressure Requirement (b) All heating appliances are simultaneously in operation with lowest stationary thermal input (min. output).

Mass Flow (g/s)	mw_c	mw	mw_c - mw	
Appliance 2	11	11	0	**+++**
Appliance 1	11	11	0	**+++**

Pressure Requirement (c) Only one heating appliance is in operation with maximum thermal input (nom. output). All other ones are out of operation.

Mass Flow (g/s)	mw_c	mw	mw_c - mw	
Appliance 2	145.3	145.3	0	**+++**
Appliance 1	145.3	145.3	0	**+++**

Pressure Requirement (d) Only a heating appliance with lowest stationary nominal output (min. output) is in operation. All other ones are out of operation.

Mass Flow (g/s)	mw_c	mw	mw_c - mw	
Appliance 2	11	11	0	**+++**
Appliance 1	11	11	0	**+++**

Detailed Results - Reflux at Nom. Output

Reflux at Nom. Output All heating appliances, except one, are in operation with maximum thermal input (nom. output). At the inlet behind this heating appliance, no positive pressure must occur if no none-return-valve is available.

	P_Z-P_{LU} (Pa)		Non-Return Valve	ok?
Appliance 2 (Entry 2)	6.6	(Neg. Press.)	Yes	**+**
Appliance 1 (Entry 2)	5.8	(Neg. Press.)	Yes	**+**

Detailed Results - Temperature Requirement

Temperature Requirement Test concerning ice accretion: The upper inside wall temperature % % must not fall below the freezing point % %.

Temperature (°C)	t_{iob}	t_g	t_{iob}-t_g	
Section 1	-5.5	0	-5.5	**-**

Jeremias UK Ltd
Unit 2-4 Long Stoop Way, Crown Farm Industrial Estate
Mansfield, Nottinghamshire, NG22 0FQ
Tel: 01623 889219
sales@jeremias.uk
www.jeremias.uk

Calculation of Chimneys according to EN 13384-1

Date	18/05/2018

Design of Plant - Single Appliance

Calculated according to	EN 13384-1
Chimney	House Chimney
Position/Run	Inside Building
Fresh Air Supply	Dependent on Room Air
Air Supplied by	From Installaion Room
Sections	Connector: 1, Chimney: 1
Outlet	Open Outlet Zeta = 0



Environment

Geodetic Height	50 m
Safety Factor SE	1.2
Correction Factor SH	0.5

Ambient Air Temperatures (Standards)

At top Outlet	-15 °C	(Temperature Requirement)
Outside Area	-15 °C	(Temperature Requirement)
In Unheated Areas	0 °C	(Temperature Requirement)
In Heated Areas	20 °C	(Temperature Requirement)
Ambient Air	15 °C	(Pressure Requirement)

Appliance

Category	Gas Motor
Manufacturer, Model	Ener.G E70
Fuel	Natural Gas
	High Fire
Nominal Output (Net)	70 kW
Nominal Output (Gross)	204 kW
CO2 Level	10.05 %
Mass Flow	272 kg/h
Temperature	120 °C
Maximum Feed Pressure	2000 Pa
Actual Feed Pressure	892.4 Pa
Appliance Outlet	Round 100 mm
Required Air (Factor Beta)	0.9

Installation Room

Category	Installation Room
Fresh Air	Windows, Opening from Outside
Extract Air	None

Connector - Construction

Category	Twin Wall Connector
Manufacturer, Model	Jeremias dw-kl Modell 0.5
Cross Section	Round 100 mm
Thermal Resistance	0.501 m²K/W
Thickness	33.7 mm
Inner Wall Material	Stainless Steel
Rugosity	1 mm
Product Classification	T600 H1 W
Suitable acc. to	Technical specifications 9174-041-DoP-2017-06-16

Connector - Geometrie

Resistances	Segment Bend (3) 87 °
Effective Height	1 m
Drawn Lenght	2.5 m
Portion in outside areas	0 %
Portion in unheated areas	0 %
Portion in heated areas	100 %

Chimney - Construction

Category	Twin Wall Chimney
Manufacturer, Model	Jeremias dw-kl Modell 0.8
Cross Section	Round 100 mm
Thermal Resistance	0.501 m²K/W
Thickness	33.7 mm
Inner Wall Material	Stainless Steel
Rugosity	1 mm
Product Classification	EN 1856-1 - T600 H1 W V2 L50060 G
Chimney Classification	EN 15287 - T600 H1 W 2 G L00 (R0.50)
Suitable acc. to	Technical specifications 9174-002-DoP-2013-06-17

Chimney - Geometrie

Resistances	None
Effective Height	34 m
Drawn Lenght	34 m

Chimney - Course (Inside Building)

Portion in outside areas	0 %
Portion in unheated areas	0 %
Portion in heated areas	100 %
Building Contact	All Sides
Additional Insulation	
Outside Area	canceled
In Unheated Areas	canceled

Outlet Resistance

Outlet Resistance	Open Outlet
Zeta	0

Entry

Resistance	Tee 87 °

Additional Results

Outlet Cross Section	78.5 cm²	
E'flux	10.54 m/s	
Flue Gas Density	0.913 kg/m³	
Flow Noise	35.3 dB(A)	
Max. Downwash	Wind Velocity	
At TL = -15 °C	22.72 m/s	
At TL = +15 °C	25.36 m/s	
Theoretical Draught	96.4 Pa	
Flue Gas Density	0.832 kg/m³	
Velocity	11.56 m/s	
Maximum Draught	152 Pa	(Negative Pressure At Flow Separation)

Layer Temperatures

Temperatures at the outside surface of the respective layer nearby the inlet.

Section 1		
Flue Gas		117 °C
Inner Wall		114 °C
Wall (R50)	33.7 mm	32 °C
Ambient Air		20 °C

Result of Calculation - Chimney

Mode: Planned With Positive Pressure, Wet

Requirement	Form.	Unit	High Fire	
Pressure Requirement	P_{ZOe}-P_{ZO}	Pa	0	+++
Pos. Pressure at Entry	P_{exc}-P_{ZO}	Pa	4184.2	+
Pos. Pressure inside Connector	P_{exc}-P_{ZO}	Pa	4110.6	+
Temperature Requirement	t_{iob}-t_g	°C	95.5	+++

Additional Information

Chimney Velocity	w_m	m/s	11.02

All of the mentioned conditions for the check of the function of the chimney are fulfilled. The plant fits all conditions of standard EN 13384-1.

Hints

The actual feed pressure of the heating appliance is 892.4 Pa.

The test of the terms for min. output is dropped because no performance range is indicated for the heating appliance.

The reserve of pressure Pexc - Pzo which is given in the results is the difference between the maximum allowed pressure for the flue system Pexc and the actual pressure inside the flue Pzo. If there is negative pressure inside the flue this difference is of course greater (!) than the maximum allowed pressure Pexc itself.

Appendix F

AIR QUALITY PLAN EXTRACT

Jeremias UK Ltd
Unit 2-4 Long Stoop Way, Crown Farm Industrial Estate
Mansfield, Nottinghamshire, NG22 0FQ
Tel: 01623 889219
sales@jeremias.uk
www.jeremias.uk

RADIUS OF CONCERN (5U) IN ACCORDANCE Clean Air Act 1956

DATE:	04/07/2018
QUOTE REF NO:	OF 02026 11115 Rev 1
NAME OF PROJECT:	Comag Building, West Drayton
CUSTOMER:	Patrick Parsons
FAO:	Aled Williams

CHP MW Input (Gross)	0.214
Safety Factor	4.0
Boiler MW Input (Gross)	0.585
Building Height	33.0
Height Above Roof	**3.0**
Radius of Concern 5U (M)	**8.5**

Please note the above safety factor has been implemented to assume the potential emmisions that may be dispersed by the CHP appliance.

Notes;

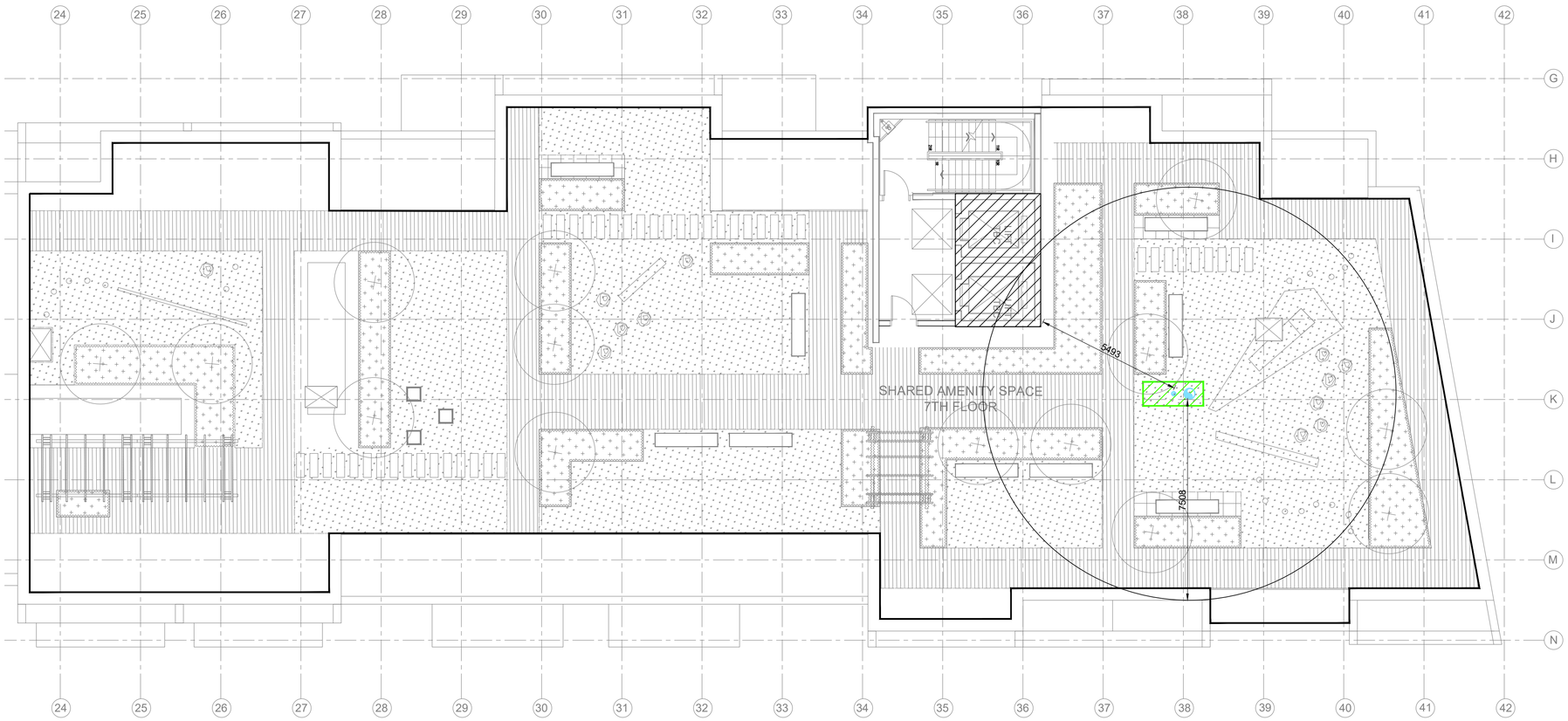
All termination heights and final position of our flue systems, you must seek approval off the relevant local Environmental officer, in line with the current regulations using either Clean Air Act (and memorandum)/LAQM (09)/D1 Ministry of Pollution dependant on the appliances being selected for the project. We at Jeremias are not responsible for sourcing the necessary approvals, we can only presume at the time of this tender that it has been obtained already by the professional team.

We at Jeremias UK assume information provided above is accurate, should new information become available that will effect the calculation.

Should any taller structure (including overruns that are greater than 1% of the total roof area) and air inlets / openable windows fall within the radius above, the flue termination is required to terminate 1.0M higher than the taller structure or 3.0M higher than the air inlet/openable window.

Appendix G

FLUE LOCATION PLAN



FLUE PROXIMITY PLAN
SCALE 1:100

GENERAL NOTES
1.1. THIS DRAWING IS COPYRIGHT AND SHOULD NOT BE REPRODUCED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF PATRICK PARSONS LTD.
1.2 DO NOT SCALE FROM THIS DRAWING.

NOTES

1. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH MEP TECHNICAL NOTE PLANNING CONDITION 13.
2. FLUE DISCHARGE HEIGHT ABOVE ROOF FFL 5.25m
3. THIS DRAWINGS SHALL BE READ IN CONJUNCTION WITH DRAWINGS L17035-SK-M02 AND M03

LEGEND

LIFT OVERRUN

ROOF AREA

Rev.	Amendments	Date	By
P1	INITIAL ISSUE.	05.07.18	AW

Revisions

PATRICK PARSONS
Built Environment | Engineering | Consultancy

Unit 5
St John's Court
Chester
CH1 1QE

T. +44 (0)1244 902 000
E. info@patrickparsons.co.uk
W. www.patrickparsons.co.uk

Client
REDROW LONDON LTD

Project
COMAG BUILDING, WEST DRAYTON

Drawing
PROPOSED FLUE PROXIMITY PLAN

Scales 1:100 At original size A1

Drawn AW
Date JULY 18

Checked AW

Status PRELIMINARY

Drawing No. L17035-SK-M-01 Rev. P1