Energy Strategy

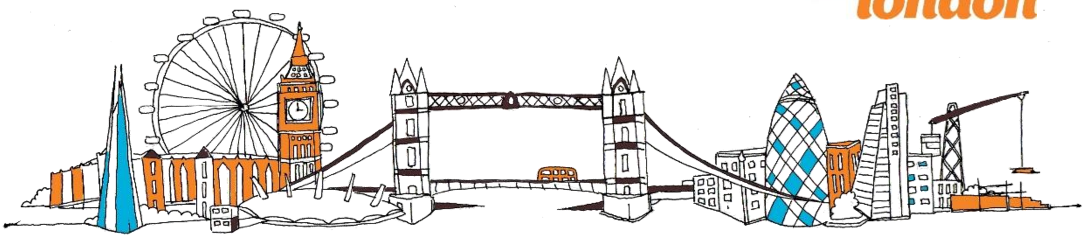
Ham Close Regeneration, Richmond

On behalf of Hill Residential

R05

Date: October 22

energist london



REVISION HISTORY

Revision	Issue Date	Description	Issued By	Checked By
R00	03/02/22	First Issue - DRAFT	JA	TW
R01	08/03/22	Updated with comments	JA	TW
R02	27/04/22	Updated with comments	JA	-
R03	17/08/22	Updated with GLA comments	JA	TW
R04	03/10/22	Updated with LBRuT comments	JA	TW
R05	12/10/22	Updated with LBRuT comments	JA	-

Calculations contained within this report have been produced based on information supplied by the Client and the design team. Any alterations to the technical specification on which this report is based will invalidate its findings.

All advice provided by Energist UK Ltd regarding the performance of materials is limited solely to the purposes of demonstrating compliance of the Energy Strategy. The performance of materials under other criteria, including but not limited to fire, structural, acoustics are not considered in our advice. It is the responsibility of the client to ensure the wider suitability of materials specified in our assessments.

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EXECUTIVE SUMMARY

This Energy Strategy has been produced by Energist UK on behalf of Hill Residential ('the Applicant'). It supports a full planning application for the regeneration of Ham Close, Ham, Richmond upon Thames, TW10 7PG ('the Site'). The development proposals comprise the demolition of the existing buildings on-site and phased mixed-use development comprising 452 residential homes (Class C3) up to six storeys; a Community/Leisure Facility (Class F2) of up to three storeys in height, a "Maker Labs" (sui generis) of up to two storeys together with basement car parking and site wide landscaping ('the Development'). This application is being submitted to the London Borough of Richmond upon Thames.

By adopting principles of sustainable design, and through the incorporation of efficient, Low and Zero-Carbon (LZC) technologies, the Applicant will successfully deliver The London Plan (2021) planning policies, with reference to *Policy D4 Housing Quality and Standards; Policy SI1 Improving air quality; Policy SI2 Minimising Greenhouse Gas Emissions; Policy SI3 Energy Infrastructure and Policy SI4 Managing Heat Risk.* This Energy Strategy has been written in accordance with the Energy Assessment Guidance, *Greater London Authority guidance on preparing energy assessments as part of planning applications* (2020).

The Applicant is committed to a design approach that aligns with the principles of the energy hierarchy. The development will achieve a total reduction in regulated CO_2 emissions of 66% betterment over the Target Emission Rate (TER) Approved Document Part L (AD L) 2013 through Be Lean, Be Clean and Be Green measures.

SAP10 carbon emission factors will be adopted in order to estimate, more accurately, the predicted energy performance and actual carbon emissions associated with the development. This is in accordance with the recommendations of the Energy Assessment Guidance (2020).

Be Lean: Passive design measures have been included and lead to a significant reduction in regulated CO_2 emissions over the AD L 2013 TER and Target Fabric Energy Efficiency (TFEE) standard. A combination of 'Be Lean' measures including energy-efficient building fabric; insulation to all heat loss floors, walls and roofs; double-glazed windows; low-energy lighting; and efficient heating and ventilation systems all contribute to an enhancement in the energy performance. This report demonstrates a 10% domestic improvement, and a 37% non-domestic improvement when using SAP10 emission factors, which exceeds the 10% and 15% targets (respectively) set out within the London Plan Policy SI 2.

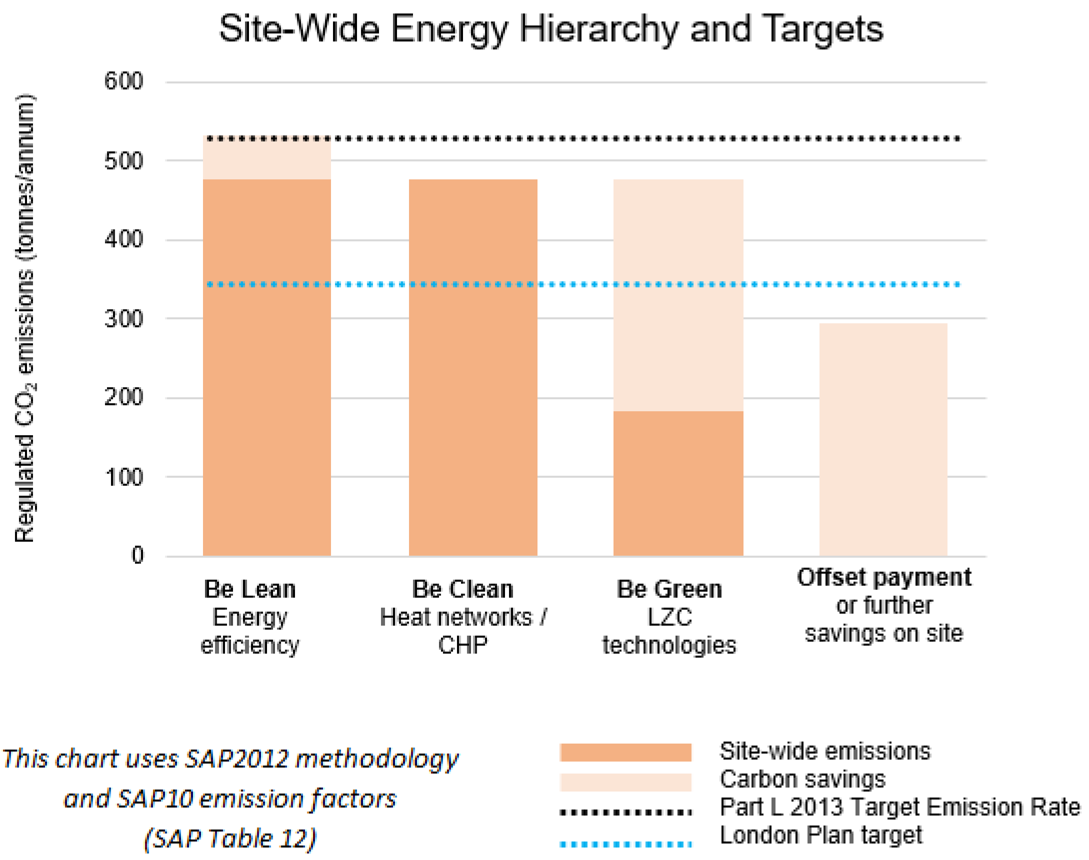
Be Clean: The feasibility of supplying decentralised energy to the development has been assessed in accordance with the heating hierarchy. The site is located outside of a Heat Network Priority Area and there are no existing or proposed heat networks within the vicinity of the site. In order to future proof the development the Applicant proposes a communal network, capable of connecting to any future District Heat Network should one become available. The communal network shall be an all-electric Air Source Heat Pump (ASHP) led system serving the heating and hot water demands for each of the apartment blocks.

Be Green: After maximising the 'Be Lean' design measures to reduce energy demand, the proposed strategy is to implement a site-wide communal heat network supplied by highly efficient heat pumps. This will supply efficient and low carbon space heating and hot water to all units within the apartment blocks. Houses and non-domestic spaces are proposed to be supplied by individual heat pumps, with a carbon and fuel cost assessment provided for the houses. The renewables contribution will be maximised by the inclusion of solar photovoltaics (PV) to suitable roof spaces. The incorporation of the ASHP technology and solar PV arrays will deliver a 66% reduction in domestic regulated CO_2 emissions, and 60% reduction in non-domestic regulated CO_2 emissions over AD L 2013. Site-wide this represents a 66% reduction in regulated CO_2 emissions, thus exceeding the required standard of 35% improvement over the baseline.

The development has maximised every opportunity to reduce emissions where practicable on site through a combination of efficient fabric and design; efficient heating systems and maximising suitable roof spaces for solar PV installation to make significant reductions in CO_2 emissions against the baseline. The development will achieve the zero-carbon target through a carbon-offset payment which offsets the shortfall in regulated CO_{2}-emissions.

Appendix 1 contains a list of abbreviated terms.

Site-wide Results



This chart uses SAP2012 methodology and SAP10 emission factors (SAP Table 12)

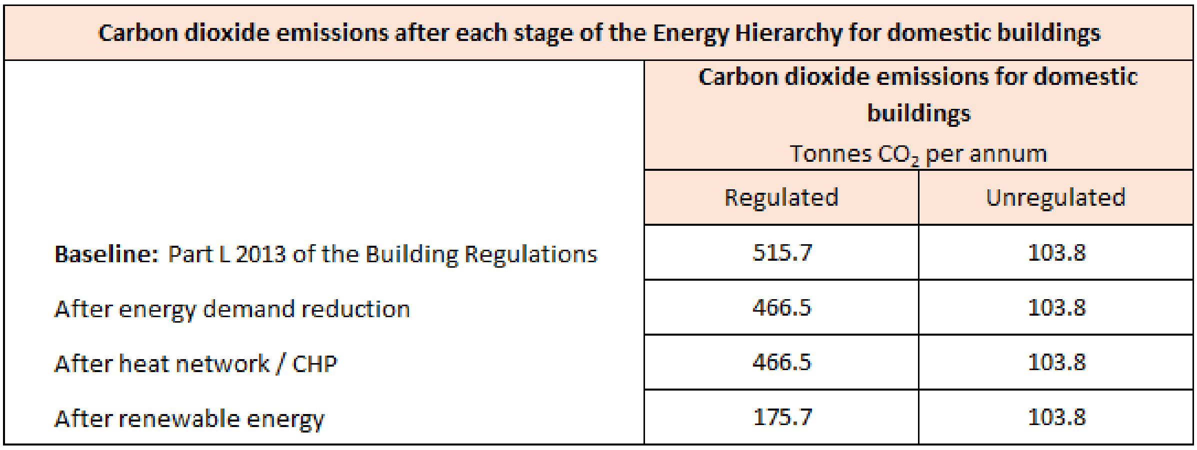
Figure 1 – Site-wide carbon savings and energy targets for The London Plan (SAP10)

Table 1 - Summary of the site-wide regulated CO_2 savings at each stage of the energy hierarchy (SAP10)

Site-wide regulated carbon dioxide savings from each stage of the Energy Hierarchy		
	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	% reduction
Savings from energy demand reduction	54.9	10%
Savings from heat network / CHP	0.0	0%
Savings from renewable energy	294.5	55%
Cumulative on site savings	**349.3**	**66%**
Carbon shortfall	181.7	-
Cumulative savings for offset payment	**5,452**	**tonnes CO_2**
Cash-in-lieu contributions	**£ 517,978**	

Domestic Results

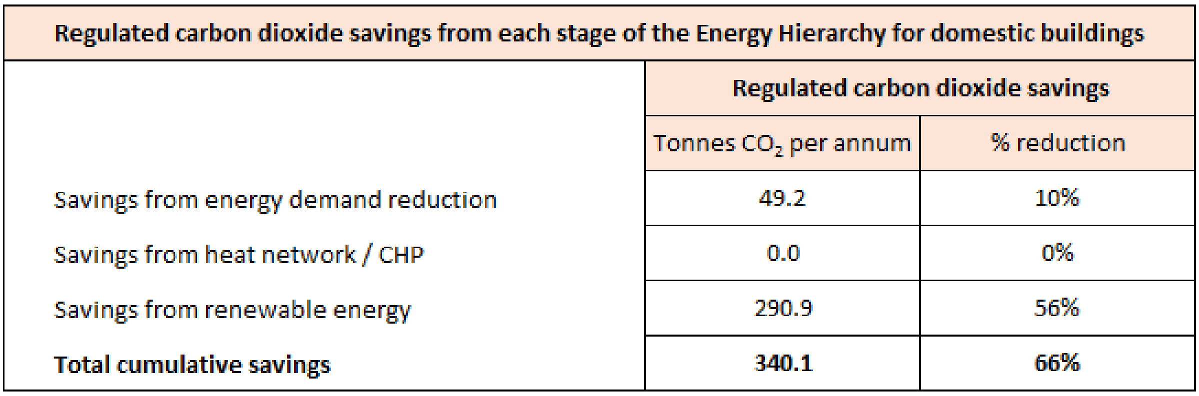
Table 2 - Domestic carbon emissions from each stage of the energy hierarchy (SAP10), for regulated and unregulated energy emissions



Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings		
	Carbon dioxide emissions for domestic buildings Tonnes CO_2 per annum	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	515.7	103.8
After energy demand reduction	466.5	103.8
After heat network / CHP	466.5	103.8
After renewable energy	175.7	103.8

** Regulated energy emissions are associated with building regulations, and include emissions from heating, cooling, lighting, and hot water. Unregulated emissions are associated with cooking equipment, small appliances, and other plug in equipment.*

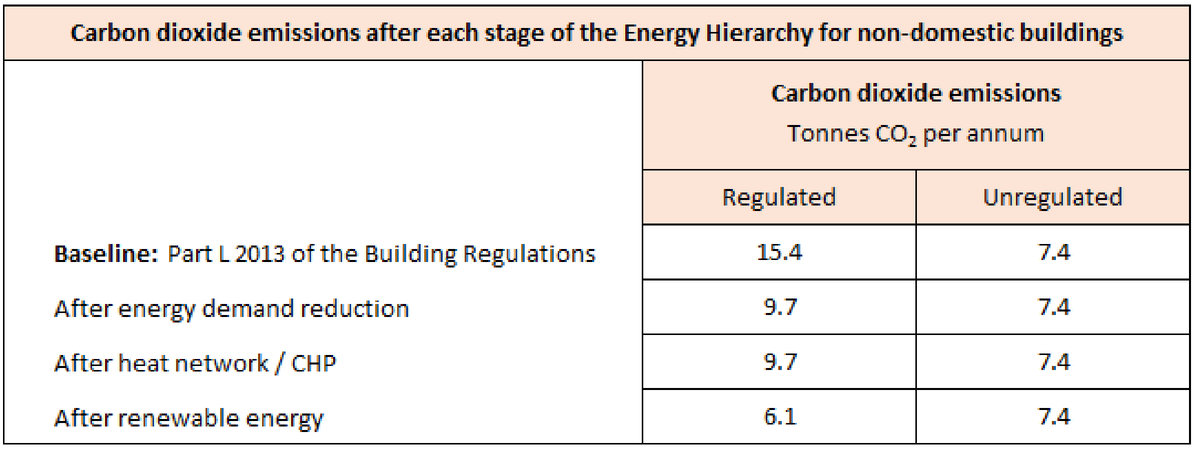
Table 3 - Domestic carbon emission savings from each stage of the energy hierarchy (SAP10)



Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings		
	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	% reduction
Savings from energy demand reduction	49.2	10%
Savings from heat network / CHP	0.0	0%
Savings from renewable energy	290.9	56%
Total cumulative savings	**340.1**	**66%**

Non-domestic Results

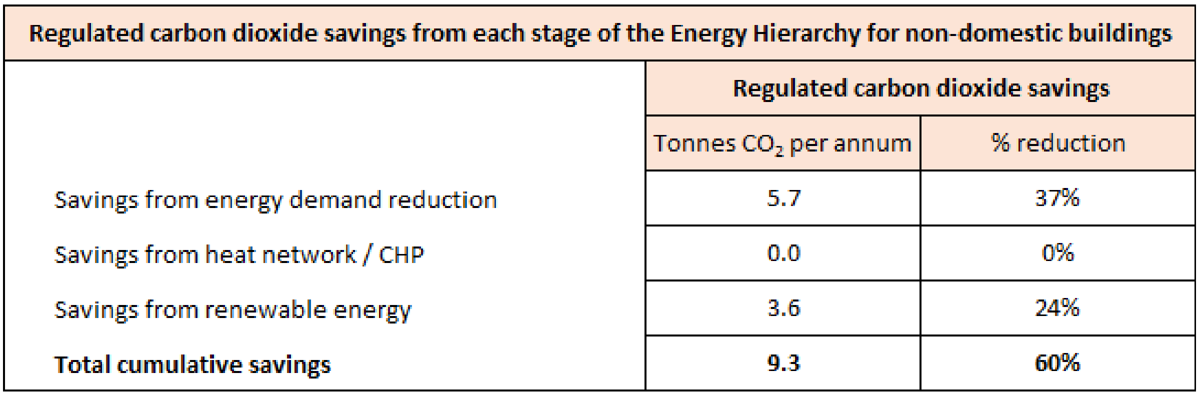
Table 4 – Non-domestic carbon emissions from each stage of the energy hierarchy (SAP10), for regulated and unregulated energy emissions



Carbon dioxide emissions after each stage of the Energy Hierarchy for non-domestic buildings		
	Carbon dioxide emissions Tonnes CO_2 per annum	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations	15.4	7.4
After energy demand reduction	9.7	7.4
After heat network / CHP	9.7	7.4
After renewable energy	6.1	7.4

** Regulated energy emissions are associated with building regulations, and include emissions from heating, cooling, lighting, and hot water. Unregulated emissions are associated with cooking equipment, small appliances, and other plug in equipment.*

Table 5 – Non-domestic carbon emission savings from each stage of the energy hierarchy (SAP10)



Regulated carbon dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings		
	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	% reduction
Savings from energy demand reduction	5.7	37%
Savings from heat network / CHP	0.0	0%
Savings from renewable energy	3.6	24%
Total cumulative savings	**9.3**	**60%**

1. INTRODUCTION

This Energy Strategy has been produced by Energist UK on behalf of Hill Residential (‘the Applicant’).

It sets out the climate change mitigation measures incorporated by the Applicant in support of a full planning application for the regeneration of Ham Close, Ham, Richmond upon Thames, TW10 7PG. The development proposals comprise the demolition of the existing buildings on-site and phased mixed-use development comprising 452 residential homes (Class C3) up to six storeys; a Community/Leisure Facility (Class F2) of up to three storeys in height, a “Maker Labs” (sui generis) of up to two storeys together with basement car parking and site wide landscaping (‘the Development’). This application is being submitted to the London Borough of Richmond upon Thames.

This Energy Strategy will demonstrate the approach adopted by the Applicant to comply with:

i) National Planning Policy Framework.

ii) The London Plan (2021) planning policies SI1 to SI4 on climate change mitigation measures to:

- Achieve a minimum 35% on-site reduction in CO_2 emissions over Approved Document Part L (AD L) 2013, based on SAP10 emission factors by implementing principles of the energy hierarchy.
- Achieve a minimum 10% domestic, and 15% non-domestic, improvement on Building Regulations from energy efficiency (Be Lean).
- Achieve zero carbon. Where this cannot be achieved on site, a commitment to offset the shortfall in CO_2 emissions through a carbon offset payment.
- Evaluate the viability of heat networks in accordance with the following hierarchy:
    1) *Connection to an area wide heat network*
    2) *Communal heating system:*
        - *Site-wide heat network*
        - *Building-level heating system*
    3) *Individual heating system*
- Reduce the potential for overheating through the incorporation of passive design measures in accordance with the cooling hierarchy.
- Maximise opportunities for the installation of renewable energy technologies.

iii) Energy Assessment Guidance, Greater London Authority guidance on preparing energy assessments as part of planning applications (2020).

iv) Local planning policy requirements for the London Borough of Richmond upon Thames set out in the Local Plan (2018), Policy LP20: Climate Change Adaptation, and Policy LP22: Sustainable Design and Construction, as well as the Sustainable Construction Checklist Guidance Document (June 2020).

v) London Borough of Richmond upon Thames Climate Emergency. The LBRuT declared a climate emergency in 2019 and has set out a climate emergency strategy and action plan to mitigate the impact of extreme temperature, flooding, water supply, and biodiversity, and focuses on decarbonisation and achieving zero-carbon ready assets.

Although not currently applicable to the development, the introduction of Approved Document Part L 2021 has been considered. The proposed approach is considered compatible with the new building regulations, as it utilises an all-electric heating solution which benefits from the continued decarbonisation of the national grid.

In accordance with the recommendations of *Energy Assessment Guidance* (2020), the Applicant now adopts SAP10 emission factors in order to estimate more accurately the carbon emissions associated with the proposed development.

This Energy Strategy describes demand-reduction measures, energy-efficiency measures and Low- and Zero-Carbon (LZC) technologies in relation to how the Applicant meets the objectives of the energy hierarchy: Be Lean, Be Clean and Be Green.

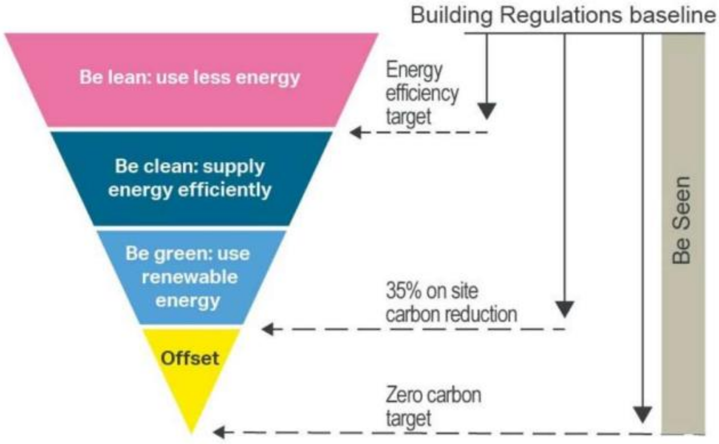


Figure 2 - The London Plan Energy Hierarchy

2. DEVELOPMENT OVERVIEW

This Energy Strategy has been produced for the proposed regeneration of Ham Close, Ham, Richmond upon Thames, TW10 7PG. A Full Detailed Planning Application is being submitted to the London Borough of Richmond upon Thames.

The site is located on Ham Close, between St Richard's CE Primary School and Ham Street/Wiggins Lane, in a predominantly residential setting. The site is an existing Richmond Housing Partnership (RHP) owned estate, with 6 small parcels of land owned by the London Borough of Richmond Upon Thames. An agreement is in place for RHP to purchase the parcels to enlarge the development site. The site has 14 existing residential blocks, plus some ancillary uses including garages. The site is allocated in the local plan for redevelopment.

The under-occupied existing site has been selected to be regenerated to provide a mixed-use development comprising 452 residential homes (Class C3) up to six storeys; a Community/Leisure Facility (Class F2) of up to three storeys in height, a “Maker Labs” (sui generis) of up to two storeys together with basement car parking and site wide landscaping.

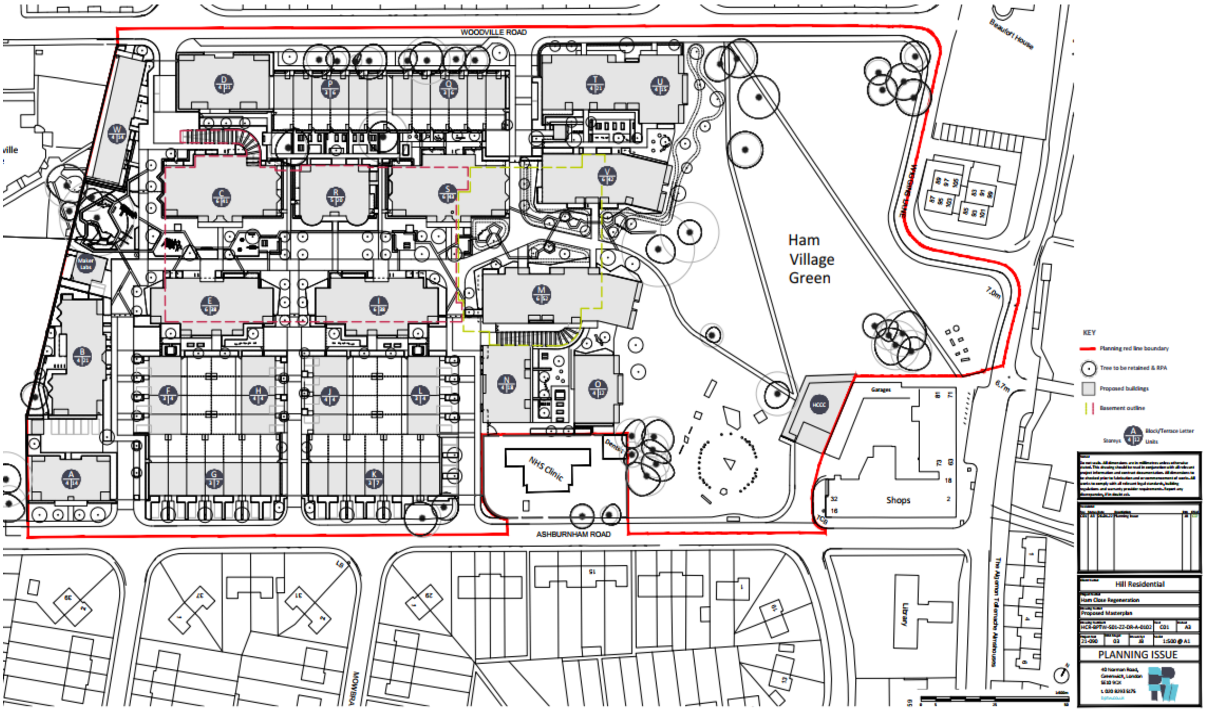


Figure 3 - Masterplan providing an overview of the site layout (BPTW drawing HCR-BPTW-S01-ZZ-DR-A-0102-C01)

The properties proposed are a combination of one, two and three bedroom flats, as well as a small number of four and five bedroom houses.

Table 6 - Development housing and apartment provision

Unit Type	**Quantity**	**GIA (sqm)**
Studio	4	34,521.2
1 Bed Flat	220	
2 Bed Flat	165	
3 Bed Flat	21	
4 Bed House	34	7,291.6
5 Bed House	8	
Total	**452**	**41,812.8**

Table 7 - Development non-domestic provision

Unit Type	**Quantity**	**GIA (sqm)**
Community Centre	1	716
Maker Labs	1	130
Total	**2**	**846**

3. METHODOLOGY

The purpose of the Energy Strategy is to demonstrate the Applicant's commitment to delivering the principles of the energy hierarchy. The Strategy is assessed against, and presented, to align with the following steps:

The Baseline: The development's baseline energy demand and the Target Emission Rate, will be calculated to establish the minimum on-site standard for compliance with AD L 2013, based on SAP10 carbon emission factors. The baseline is calculated using a mains gas heating system.

Be Lean: The development's Dwelling Emission Rate (DER) and Building Emission Rate (BER) will be calculated to explain how the Applicant's design specification has led to a reduced energy demand and an improved fabric-energy efficiency.

Be Clean: The potential to provide energy to the development in an efficient way, by either connecting to a District Heat Network (DHN) or installing a site-wide, low-carbon energy system on site.

Be Green: Low- and Zero-Carbon (LZC) technologies will be assessed for their suitability and viability in relation to the development. Solutions will be put forward for the development and the resulting regulated CO_2 emission savings presented.

Be Seen: The Applicant will look at ways to reduce the performance gap between design stage calculations and real-life performance of the systems specified as well as considering ways to keep costs for the occupants to a minimum.

Carbon Offset: Where it is demonstrated that the energy target for the development cannot be met onsite, then the shortfall in regulated CO_2 emissions reduction will be offset through a cash-in-lieu payment.

3.1 ASSESSMENT METHODS

At each stage of the energy hierarchy, the estimated energy performance of the development has been calculated using the SAP 2012 and SBEM v5.6.b.0 NCM methodology to calculate representative residential and commercial units consisting of each domestic home type configuration and a sample non-domestic unit. This sample size is considered appropriate for the purposes of extrapolation.

SAP calculates the regulated energy demands associated with hot water, space heating and fixed electrical items. Part L1A is used for the purposes of the new build energy assessment. The cumulative floor areas for a representative 45 sample dwellings have been used to estimate the TER and DER for new dwellings within the regeneration proposals.

The SBEM v5.6.b.0 NCM methodology calculates the regulated energy demands associated with hot water, space heating and fixed electrical items. Part L2A is used for the purposes of the new build energy assessment. The Community Centre has been used as the sample unit to estimate the TER and BER for new non-domestic elements within the regeneration proposal.

In order to more accurately reflect the carbon emissions associated with the expected operation of the proposed development, and to demonstrate the way in which the Applicant will meet planning policy targets, outputs from the energy assessment in SAP 2012 and SBEM v5.6.b.0 NCM have been manually converted using SAP10 emission factors, in accordance with the GLA Energy Assessment Guidance (2020).

4. THE DEVELOPMENT BASELINE

In order to measure the effectiveness of ‘Be Lean’ demand-reduction measures, it is first necessary to calculate the baseline energy demand for the development and this has been done using SAP 2012 or SBEM v5.6.b.0 NCM methodology, based on SAP10 emission factors. This is also referred to as the Target Emission Rate (TER).

The resulting AD L 2013 TER for the development has been calculated using Part L model designs which have been applied to the Applicant’s development details. The TER, or baseline energy demand represents the maximum regulated CO_2 emissions that are permitted for the development in order to comply with AD L 2013.

The resulting TER under AD L 2013 has been calculated as 515.7 t.CO_2/yr for domestic, and 15.4 t.CO_2/yr for non-domestic areas. Refer to Appendix 3 for energy assessment summary and SAP10 spreadsheet and Appendix 4 for sample TER and DER worksheets and BRUKLs.

5. BE LEAN: REDUCED ENERGY DEMAND

The development achieves a high quality sustainable design by integrating the following passive and active design measures to reduce energy demand:

- Energy-efficient building fabric and insulation to all heat loss floors, walls and roofs, targeting a low heat demand.
- High-efficiency glazing throughout.
- Quality of build will be confirmed by achieving good air-tightness results throughout.
- Efficient-building services including high-efficiency heating systems and mechanical ventilation with heat recovery.
- Low-energy lighting throughout the building.

Designing an efficient thermal envelope will greatly reduce the need for space heating as heat transmittance through the thermal elements is reduced, whilst low air permeability rates will also reduce heating demand by reducing the volume of air that can penetrate the building, minimising heat losses in the winter and heat gains in the summer.

As part of a ‘fabric first’ approach, the building fabric has been carefully considered and specified to meet or exceed current Building Regulations minimum requirements, along with the specification of energy efficient plant. The following ‘Be Lean’ design specification is proposed.

Table 8 - Be Lean: Proposed design specification

Element	'Be Lean' Design Specification
Ground Floor U-Value (W/m^2.K)	Domestic: 0.10 Non-domestic: 0.12
External Wall U-Value (W/m^2.K)	Domestic: 0.16 Non-domestic: 0.15
Party Wall U-Value (W/m^2.K)	Domestic: 0 (fully filled and sealed)
Roof (Flat) U-Value (W/m^2.K)	Domestic: 0.10 Non-domestic: 0.12
Door U-Value (W/m^2.K)	Domestic: 1.0 Non-domestic: 1.2
Glazing U-Value (W/m^2.K)	Domestic: 1.2 (double-glazed units) Non-domestic: 1.1
Glazing G-Value	0.5
Design Air Permeability	Domestic: 4 Non-domestic: 3
Thermal Bridging	Bespoke PSI values
Ventilation	Domestic: MVHR MRXBOXAB-ECO3 or similar Non-domestic: MVHR 80% eff., 0.5 W/(l/s)
Cooling	Domestic: natural ventilation Non-domestic: VRF SEER 4.0
Lighting	Domestic: 100% low energy Non-domestic: 100 lm/W
Space Heating	Domestic: 89.5% efficient communal gas boiler Non-domestic: 91% efficient gas boiler
Space Heating controls	Charging system linked to use, programmer, and at least two thermostats.
Domestic Hot water	Domestic: from main heating system Non-domestic: electric point of use

5.1 BE LEAN CARBON EMISSIONS REDUCTION

The Applicant's design specification and proposed demand-reduction measures for the Development have been modelled using SAP 2012 methodology for domestic areas, and SBEM methodology for the commercial areas, applying SAP10 emission factors. This allows us to assess the effectiveness of 'Be Lean' measures as a percentage reduction in CO_2 emissions over the baseline for both domestic and commercial elements of the development separately. Refer to Appendix 3 for an energy assessment summary and Appendix 4 for sample TER and DER worksheets and BRUKLs.

By incorporating sustainable design, the Applicant will reduce regulated CO_2 emissions over AD L 2013 across the development. These reductions are illustrated below.

Table 9 – Domestic CO_2 savings from adopting an energy efficient specification (SAP10)

	Total regulated emissions (Tonnes.CO_2/yr)	Regulated CO_2 emissions savings (Tonnes.CO_2/yr)	Percentage saving (%)
AD L 2013 baseline (SAP 10)	515.7	-	-
Be Lean: savings from demand reduction	466.5	49.2	10%

Table 10 – Non-domestic CO_2 savings from adopting an energy efficient specification (SAP10)

	Total regulated emissions (Tonnes.CO_2/yr)	Regulated CO_2 emissions savings (Tonnes.CO_2/yr)	Percentage saving (%)
AD L 2013 baseline (SAP10)	15.4	-	-
Be Lean: savings from demand reduction (SAP10)	9.7	5.7	37%

5.2 TOTAL ENERGY DEMAND

The total Part L Fabric Energy Efficiency Standard (FEES) is provided for the development as a whole and set out in the table below.

Table 11 - Site-wide total energy demand from the houses and apartments

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development Total	46.12	39.50	14%

5.3 LIMITING THE RISK OF OVERHEATING

In accordance with the GLA's cooling hierarchy, the Applicant has completed an overheating risk assessment with a focus on passive design solutions.

Overheating has been analysed using the Chartered Institute of Building Services Engineers (CIBSE) TM59 methodology. The performance of sample dwellings has been assessed against the required standards of CIBSE TM59: '*Design methodology for the assessment of overheating risk in homes (2017)*'. Additionally, non-domestic areas have been assessed against the CIBSE TM52 methodology '*The limits of thermal comfort: avoiding overheating in European buildings*'.

An overheating assessment is submitted in support of the planning application and sets out the results of the CIBSE assessment in alignment with the GLA Energy Assessment Guidance (2020). The Overheating Assessment follows the cooling hierarchy measures for the proposed development.

6. BE CLEAN: HEATING INFRASTRUCTURE

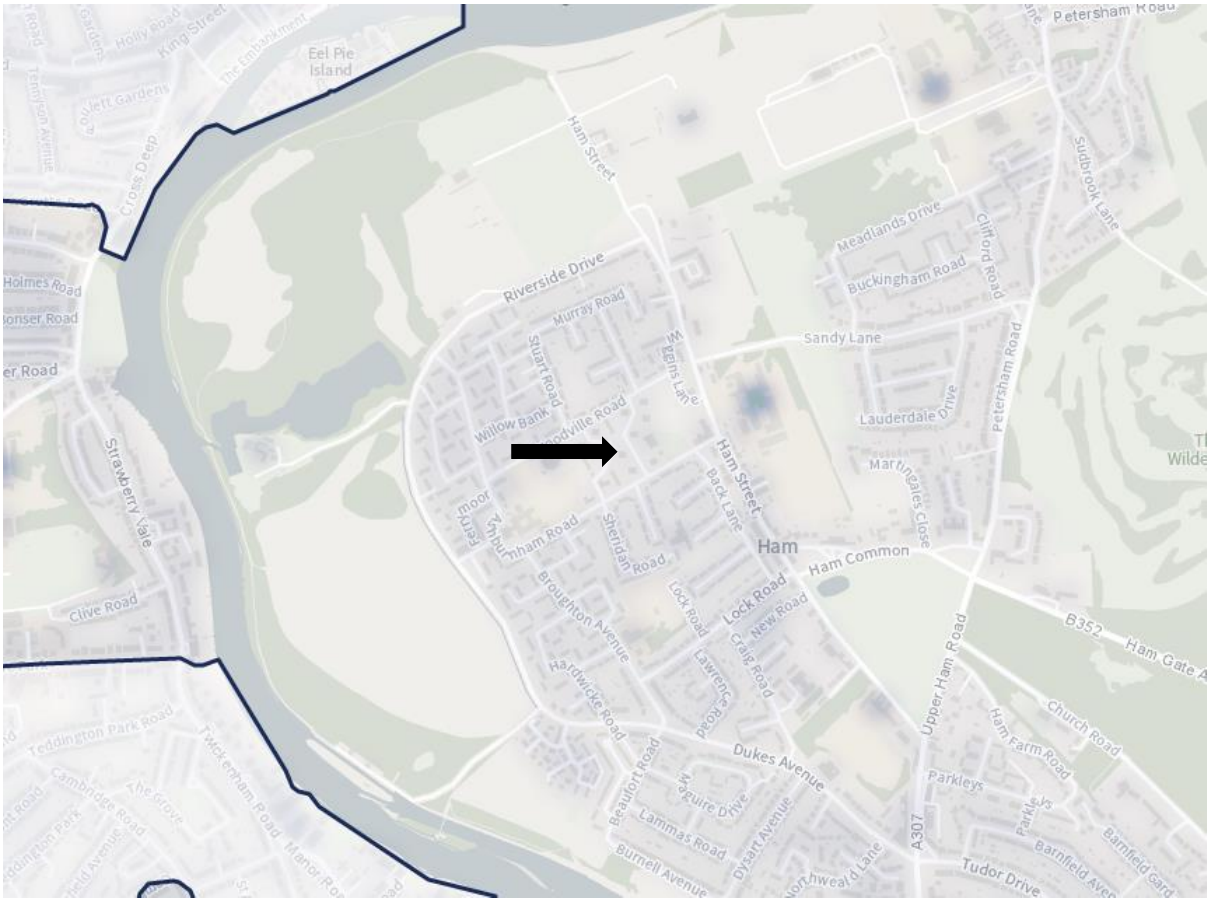
The next step in the energy hierarchy is to consider how the remaining energy demand can be met and whether there is the potential for this to be done through the mechanism of establishing and/or linking up with an existing or planned District Heat Network. This is assessed in line with planning policy SI 3 of The London Plan (2021) and the requirements of the GLA Energy Assessment Guidance (2020).

To ensure compliance with the energy hierarchy, the potential to supply energy efficiently to the development and further reduce regulated CO_2 emissions through ‘Be Clean’ measures, has been evaluated. This has been done with attention to the following hierarchy for selecting an energy system:

1. *Connection to an area wide heat network.*
2. *Communal heating system:*
    - *Site-wide heat network.*
    - *Building-level heating system.*
3. *Individual heating system.*

6.1 AREA-WIDE HEAT NETWORK

The London Heat Map has been consulted to establish whether the development lies within proximity of an existing or proposed area-wide DHN. The site is located outside of a Heat Network Priority Area and there are no existing or proposed heat networks within the vicinity of the site. The site has not been identified in the *Heat Mapping Study – London Borough of Richmond upon Thames* (Policy LP 22). In order to future proof the development the Applicant proposes a phased site-wide communal network comprised of 1 no. energy centre serving Phase 1 apartments, and 1 no. energy centre serving Phase 2 & 3 apartments, capable of connecting to any future District Heat Network should one become available. The communal network shall be an all-electric ASHP led system serving the heating and hot water demands for each of the apartment blocks. It is proposed to serve the houses with individual ASHPs, with justification provided below. The non-domestic buildings shall be served via VRF heat pumps. In accordance with the GLA Energy Assessment Guidance (2020) the carbon savings from heat pumps are recorded under the Be Green section.



🟦	Heat Mapping Decentralised Energy Potential
—	Existing DHN
—	Potential DHN
➡	Development Location

Figure 4 - Location of the development site and proximity to HNPAs and proposed DHNs

6.2 COMBINED HEAT AND POWER

A Combined Heat and Power (CHP) engine works well in developments with a constant baseline heat demand throughout the year (for example hot water demand or swimming pool) and requires operating for in excess of 5,000 hours per annum to maximise its efficiency. In addition, plant rooms must be designed specifically to accommodate CHP equipment and close attention paid to flue design to minimise the air quality impact.

Recent GLA guidance states that '*to date, gas-engine CHP has been the primary technology for facilitating the development of district heat networks due to its high efficiency and better* *carbon performance compared to electrical systems utilising grid electricity. However, the rapid decarbonisation of the electricity grid means that technologies generating onsite electricity (such as gas-engine CHP) will not achieve the carbon savings they have to date. There are also growing air quality concerns associated with combustion-based systems.*'

The decarbonisation of the national grid means that CHP systems are not a long term low carbon solution. Generated electricity does not save as much carbon as previously, and the use of CHP engines can have a significant negative impact on local air quality. It is therefore considered non-viable to specify a CHP engine.

6.3 BE CLEAN CARBON EMISSIONS REDUCTION

As a connection to an area-wide heat network is not a possibility at this time and as there are no firm plans for any future area-wide heat network within the vicinity of the development, a site-wide communal heating system will be implemented to future proof the development. There is no reduction from the 'Be Clean' element of the assessment.

6.4 HOUSE HEATING STUDY

It is proposed to provide the houses with individual ASHPs serving space heating and domestic hot water. Whilst it is acknowledged that this is lower down the heating hierarchy than connecting to a communal energy centre, the Applicant has provided an assessment of individual ASHP versus communal ASHP connection as detailed below. It is demonstrated that carbon savings are considerably higher for the houses with individual ASHP systems, and that the operational running cost for individual systems is considerably lower than connecting to a communal network. There are also embodied carbon savings to be had by providing individual heating systems, and there will be less heat loss incurred by running pipework to the houses. It is proposed that the arrangement of ASHPs within the utility cupboards will allow for future connection to a district heat network, should one become available.

The individual ASHP and communal ASHP datasheets are provided in Appendix 7, and summarised below.

Table 12 - Carbon emission comparison

System	Total regulated emissions (Tonnes CO_2/yr)	Percentage saving (%)
Individual ASHP – Be Green	31.6	68%
Communal ASHP – Be Green	52.4	47%

Table 13 - Plant specification for comparison study

System	Specification
Communal ASHP	COP – 2.08
Individual ASHP	COP – 2.6
Distribution Heat Loss	CIBSE CP1

Table 14 - Operational running cost comparison

Unit Reference	Individual ASHP cost (£)	Communal ASHP cost (£)	% Difference
Block P - Mid - HT1	540.01	562.02	-3.9%
Block Q - End - HT1	521.50	602.64	-13.5%
Block Q - Mid - HT1	521.50	562.02	-7.2%
Block G - Mid - HT 2	562.48	616.21	-8.7%
Block K - Mid - HT 3	562.48	616.21	-8.7%
Block K - End - HT 2	577.36	654.58	-11.8%
Block F - Mid - HT 5	567.21	615.86	-7.9%
Block L - End - HT 5	588.04	602.59	-2.4%
Block H - End - HT 4	761.92	883.33	-13.7%
Block J - Mid - HT 4	694.70	802.89	-13.5%

7. BE GREEN: LOW AND ZERO-CARBON TECHNOLOGIES

In line with planning policy SI 2 of The London Plan (2021) and Energy Assessment Guidance, the Applicant seeks to maximise opportunities for incorporating Low and Zero-Carbon (LZC) technologies as part of their energy strategy for the development.

In accordance with the energy hierarchy, the Applicant has adopted 'Be Lean' measures as a priority for the scheme and demonstrates a 10% reduction in regulated CO_2 emissions over the AD L 2013 baseline for domestic, and a 37% reduction in regulated CO_2 emissions over the AD L 2013 baseline for non-domestic, using SAP10 carbon emission factors.

LZC technologies have been assessed for their viability as a component of a complementary heating strategy for the development. A detailed review of the LZC technologies is provided in Appendix 5. The Applicant's adopted strategy for LZC technologies is compatible with the 'Be Lean' design specification for the apartments, houses, and community facilities.

7.1 PROPOSED LOW AND ZERO-CARBON TECHNOLOGIES

The current proposals for the development are:

- In order to future proof the development the Applicant proposes a phased site-wide communal ASHP LTHW network to Heat Interface Units, comprised of 1 no. energy centre serving Phase 1 apartments, and 1 no. energy centre serving Phase 2 & 3 apartments. This network will serve space heating and domestic hot water demand.
- Individual ASHP to houses, serving space heating and domestic hot water demand. As detailed in section 6.3 this strategy offers a slight carbon improvement and operational cost benefit to occupants.
- VRF strategy to community centre and Maker Labs, serving space heating and cooling demand. Domestic hot water to be served via electric point of use.
- The renewables contribution will be maximised by the inclusion of solar photovoltaics (PV) to suitable roof spaces (refer to Appendix 6 for PV layouts). Current allowance is set to a site wide total of 431.98 kWp.

The proposed energy strategy is an all-electric solution to space heating, cooling, and hot water generation. This takes full advantage of the decarbonisation of national grid supplied electricity, futureproofing the development as carbon emissions continue to decline with greening of the grid, enabling a zero carbon ready development.

The renewables contribution will be further maximised where practicable by the inclusion of solar photovoltaics (PV) to suitable roof spaces (refer to Appendix 6 for PV layouts). Current allowance is set to a site-wide total of 431.98 kWp, spread over the apartment blocks, houses, and community facilities. The PV will be installed on optimum roof spaces, positioned at a horizontal pitch, with little or no overshading. The PV will supplement electricity required by the ASHP systems.

Table 15 - Heating infrastructure specification

Heating Infrastructure	Detail
Heating Demand* (MWh/annum)	744
Heat Demand Met from Heat pumps	100 % space heating and DHW
Make, Model, and Efficiency of ASHP	Phase 1 – 5no. Mitsubishi Ecodan CAHV-P500 (COP 2.8) Phase 2-3 – 3no. Climaventa i-FX-N-G05/SL-A/0512 (COP 2.08) Houses – Mitsubishi PUZ-WM85VAA (COP 2.6)
Site wide primary and secondary Heat Losses	In-line with CIBSE CP1 Logstor series 3 insulation for pipework distribution, or similar
Network's operating temperatures	60°C Flow

** Heating demand estimated from SAP calculations*

Table 16 – Non-domestic predicted cooling demand

	Area weighted non-domestic cooling demand (MJ/m^2)	Total area weighted non-domestic cooling demand (MJ/year)
Actual	24.3	20,573.7
Notional	31.6	26,709.9

7.2 BE GREEN CARBON EMISSIONS REDUCTION

It has been calculated that the incorporation of the above ASHP systems and the indicated area of PV will provide a further improvement over AD L 2013 of 263.6 t.CO_2/yr or 51% for the domestic element of the regeneration. It has been calculated that the incorporation of VRF and PV will provide a further improvement over AD L 2013 of 3.5 t.CO_2/yr or 23% for the non-domestic element of the regeneration. Refer to Appendix 7 for ASHP data sheets.

Table 17 - Domestic predicted CO_2 savings from adopting proposed low and zero-carbon technologies (SAP10)

	Total regulated emissions (Tonnes.CO_2/yr)	**Regulated CO_2 emissions savings (Tonnes.CO_2/yr)**	**Percentage saving (%)**
AD L 2013 baseline	515.7	-	-
Be Lean: savings from demand reduction	466.5	49.2	10%
Be Clean: savings from heat network	466.5	0.0	0%
Be Green: savings from renewable energy	175.7	290.9	56%

Table 18 – Non-domestic predicted CO_2 savings from adopting proposed low and zero-carbon technologies (SAP10)

	Total regulated emissions (Tonnes.CO_2/yr)	**Regulated CO_2 emissions savings (Tonnes.CO_2/yr)**	**Percentage saving (%)**
AD L 2013 baseline	15.4	-	-
Be Lean: savings from demand reduction	9.7	5.7	37%
Be Clean: savings from heat network	9.7	0.0	0%
Be Green: savings from renewable energy	6.1	3.6	24%

8. BE SEEN: ENERGY MONITORING

All apartments and commercial spaces shall be provided with individual smart meters. The specific system to be adopted has not been selected and shall be subject to detailed design. However, the systems selected shall enable the monitoring of heat (where applicable) and energy via an energy display device, to allow residents to manage their energy use, including unregulated energy, in line with the GLA requirements.

In further support of reducing unregulated energy demands, which are outside the scope of influence of the Design Team, the Applicant is committed to promoting ways in which occupants and building tenants can reduce their operational unregulated energy demands, for example from display lighting, cooking equipment, small appliances, and other plug-in equipment. The Applicant shall promote this through home user guides and building users guides.

The Applicant is committed to keeping energy costs down for tenants, occupants, and commercial users throughout the scheme, and this will in part be achieved through high efficiency heat pumps with excellent primary energy delivery rates, and through the metering strategy. The proposed 431.98 kWp PV array will be used to supplement electricity required by the communal ASHP systems, helping to offset end charges to the occupants. Contractual obligations will be set up to ensure that best practice and quality standards will be followed for the operation of the communal heat network, for example the CIBSE code of practice.

The Applicant is committed to ensuring consumers are protected from high prices and ensuring there is transparency in the billing mechanisms so that occupants feel more in control of their spending, ensuring it clearly itemises the charges for ongoing maintenance, capital replacement aspects and standing charges.

For non-domestic areas, a Commissioning and Testing Schedule will be produced, and a Specialist Commissioning Manager will be appointed to ensure that plant run and operate as intended at the design stage. Building User Guides will be produced in line with BREEAM criteria to clearly identify the design intent, and ensure that occupants know how to efficiently operate the building.

To truly achieve net zero-carbon buildings we need to have a better understanding of their actual operational energy performance. Although Part L calculations and Energy Performance

Certificates (EPCs) give an indication of the theoretical performance of buildings, it is well established that there is a ‘performance gap’ between design theory and measured reality.

To address this gap the London Plan Policy SI 2 ‘Minimising greenhouse gas emissions’ introduces a fourth stage to the energy hierarchy; the ‘be seen’ stage, which requires monitoring and reporting of the actual operational energy performance of major developments for at least five years via the Mayor’s ‘be seen’ monitoring portal.

For residential uses, the methodology for reporting energy consumption (kWh/m^2) and carbon emissions estimates (Tonnes.CO$_2$/m^2) should follow a Building Regulations Part L compliant methodology using SAP. This is as per current planning calculation and reporting methodologies. For non-domestic areas, including common areas within apartment blocks and basement car park, estimates should follow the CIBSE TM54 methodology, in accordance with the GLA *Be Seen Energy Monitoring Guidance* (2021).

The predicted energy performance data from the domestic SAP and non-domestic CIBSE TM54 modelling have been collated and reported below, following the ‘Be Seen energy monitoring guidance’ (2021) and CIBSE TM54 (2022) methodology. Whilst domestic unregulated energy demands are influenced by the occupant, the unregulated energy demand for landlord communal areas are within control of the Design Team, and shall be reviewed at the detailed design stage with the aim to reduce unregulated energy demands. This shall be evidenced through the GLA ‘As Built’ webform portal.

Table 19 - Be Seen energy performance data

	Domestic energy demand from SAP (kWh)	**Non-domestic energy demand from CIBSE TM54 (kWh)**
Space heating	356,354.0	4,612.3
DHW	489,540.0	7,897.7
Lighting	144,621.0	136,833.4
Auxiliary	97,176.0	1,979.0
Cooling	0.0	4,880.0
Unregulated	445,493.6	252,128.8
Renewable generation	-333,752	-5,426.9

** Data are for a typical year.*

*** Unregulated emissions are associated with cooking equipment, small appliances, and other plug in equipment within apartments, and lifts, servers, office equipment, and external lighting for non-domestic areas.*

9. SITE-WIDE RESULTS

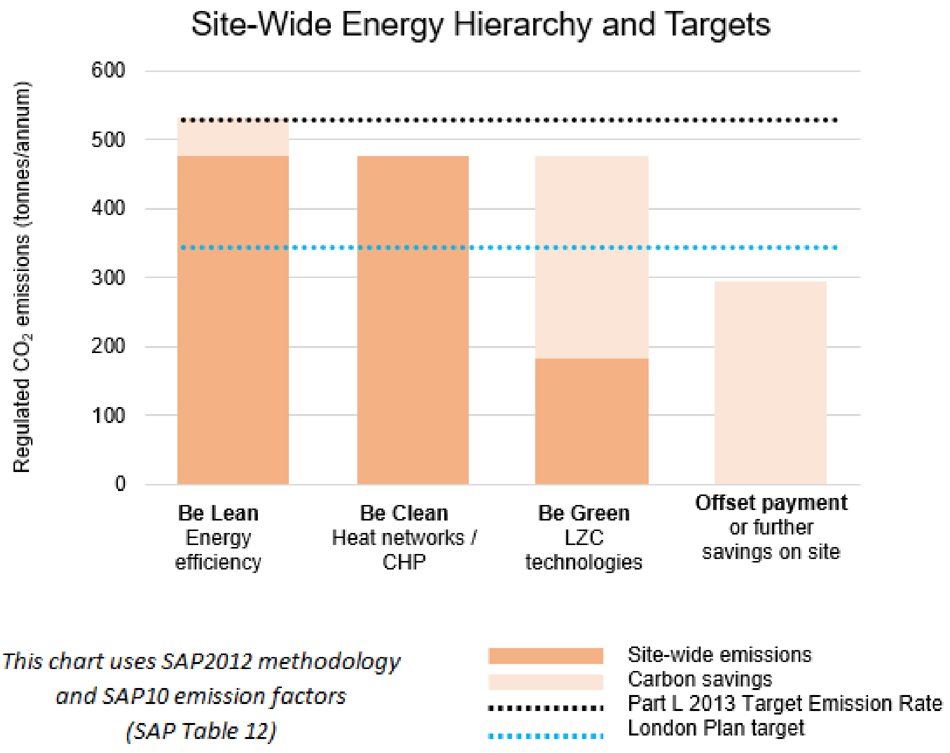
Following guidance from the GLA, the carbon emissions factors have been altered from SAP 2012 to SAP10. As such, all carbon emissions reported herein have been based on the following carbon emission factors, altered from the SAP 2012 and SBEM default factors applied to the Part L results.

Table 20 - Carbon emission factors

Fuel type	**Fuel Carbon Factor (kgCO$_2$/kWh)**	
	SAP 2012	**SAP 10.0**
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

9.1 CARBON EMISSIONS

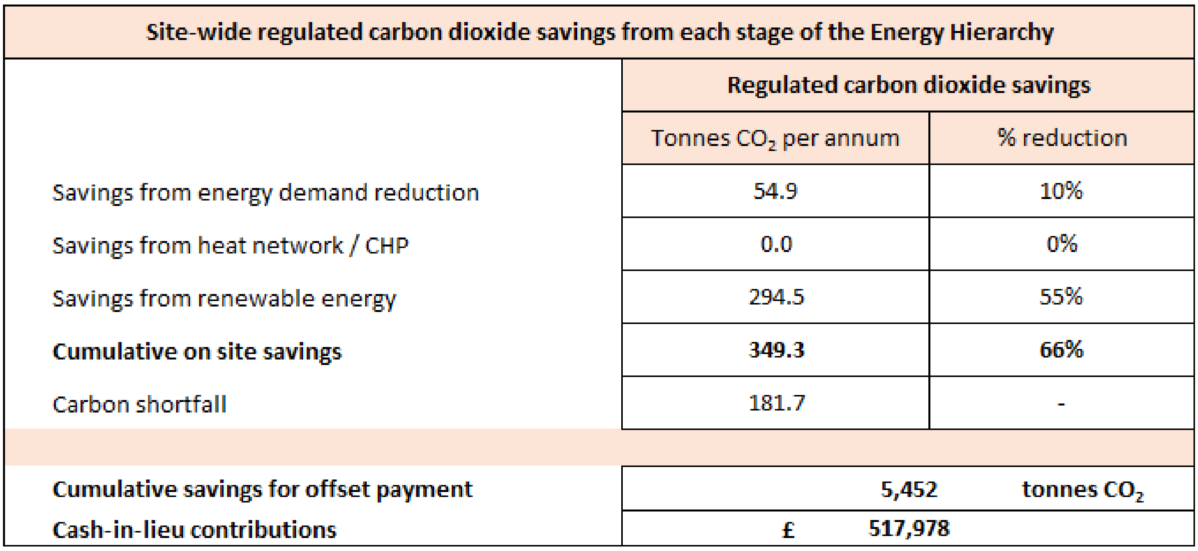
Following the Energy Hierarchy stages detailed above, the final carbon emissions are summarised below for the site.



This chart uses SAP2012 methodology and SAP10 emission factors (SAP Table 12)

Figure 5 – Site-wide carbon savings and energy targets for The London Plan (SAP10)

Table 21 - Summary of the site-wide regulated CO_2 savings at each stage of the energy hierarchy (SAP10)



Site-wide regulated carbon dioxide savings from each stage of the Energy Hierarchy		
	Regulated carbon dioxide savings	
	Tonnes CO_2 per annum	% reduction
Savings from energy demand reduction	54.9	10%
Savings from heat network / CHP	0.0	0%
Savings from renewable energy	294.5	55%
Cumulative on site savings	**349.3**	**66%**
Carbon shortfall	181.7	-
Cumulative savings for offset payment	**5,452**	**tonnes CO_2**
Cash-in-lieu contributions	**£ 517,978**	

10. CONCLUSION AND RECOMMENDATIONS

The Applicant has demonstrated a firm commitment to deliver climate change mitigation measures for the proposed development by following a design approach that aligns with the principles of the energy hierarchy. The development will achieve a total reduction in regulated CO_2 emissions of 66% over the Target Emission Rate (TER) Approved Document Part L (AD L) 2013 through Be Lean, Be Clean and Be Green measures and therefore successfully delivers the GLA London Plan target of a 35% minimum on-site reduction in regulated CO_2 emissions over AD L 2013.

SAP10 emission factors are adopted within the Energy Strategy in order to estimate, more accurately, the predicted energy performance and actual carbon emissions associated with the development.

Be Lean: Passive design measures have been included and lead to a significant reduction in regulated CO_2 emissions over the AD L 2013 TER and Target Fabric Energy Efficiency (TFEE) standard. A combination of ‘Be Lean’ measures including energy-efficient building fabric; insulation to all heat loss floors, walls and roofs; double-glazed windows; low-energy lighting; and efficient heating and ventilation systems all contribute to an enhancement in the energy performance. This report demonstrates a 10% domestic improvement, and a 37% non-domestic improvement when using SAP10 emission factors, which exceeds the 10% and 15% targets (respectively) set out within the London Plan Policy SI 2.

Be Clean: The feasibility of supplying decentralised energy to the development has been assessed in accordance with the heating hierarchy. The site is located outside of a Heat Network Priority Area and there are no existing or proposed heat networks within the vicinity of the site. In order to future proof the development the Applicant proposes a communal network, capable of connecting to any future District Heat Network should one become available. The communal network shall be an all-electric ASHP led system serving the heating and hot water demands for each of the apartment blocks.

Be Green: After maximising the ‘Be Lean’ design measures to reduce energy demand, the proposed strategy is to implement a site-wide communal heat network supplied by highly efficient heat pumps. This will supply efficient and low carbon space heating and hot water to all units within the apartment blocks. Houses and non-domestic spaces are proposed to be supplied by individual heat pumps, with a carbon and fuel cost assessment provided for the houses. The renewables contribution will be maximised by the inclusion of solar photovoltaics (PV) to suitable roof spaces. The incorporation of the ASHP technology and solar PV arrays will deliver a 66% reduction in domestic regulated CO_2 emissions, and 60% reduction in non-domestic regulated CO_2 emissions over AD L 2013. Site-wide this represents a 66% reduction in regulated CO_2 emissions, thus exceeding the required standard of 35% improvement over the baseline.

The London Borough of Richmond upon Thames declared a climate emergency in 2019. The proposed energy strategy for Ham close will deliver an all-electric heating solution which takes advantage of the decarbonisation of the national grid from renewable contributions. The strategy utilises high efficiency heat pump technology which performs well against primary energy metrics and is supplemented by renewable technology from solar photovoltaics, which has been maximised for available roof space (refer to Appendix 6).

Although not currently applicable to the development, the introduction of Approved Document Part L 2021 has been considered. The proposed approach is considered compatible with the new building regulations, as it utilises an all-electric heating solution which benefits from the continued decarbonisation of the national grid. Furthermore, the specification of high efficiency heat pumps and solar photovoltaics will result in significant improvements against the primary energy rate metric introduced under AD L 2021, whilst the building fabric under the ‘Be Lean’ section significantly betters the minimum performance requirements of AD L 2021. Under AD L 2021 the carbon emission factor for national grid supplied electricity is lower than that reported under SAP 10.0 (refer to Section 9, Table 20), therefore carbon emissions for the development under AD L 2021 are likely to be better than reported within this report.

The development will achieve the zero-carbon target through a carbon-offset payment which offsets the shortfall in regulated CO_2-emissions. The total CO_2 emissions to offset the regeneration of Ham Close have been calculated as 181.7 t.CO_2/yr. Based on a carbon price of £95 t.CO_2/yr over a 30-year period (in-line with the LBRuT Sustainable Construction Checklist Guidance Document, June 2020), this is equivalent to a cash-in-lieu contribution of £517,978**.**

11. APPENDICES

APPENDIX 1: LIST OF ABBREVIATIONS

AD L 2013	Approved Document Part L of Buildings Regulations 2013
ASHP	Air Source Heat Pump
BER	Building Emission Rate
CIBSE	Chartered Institution of Building Services Engineers
CHP	Combined Heat and Power
DER	Dwelling Emission Rate
DHN	District Heat Network
DHW	Domestic Hot Water
FEES	Fabric Energy Efficiency Standard
GLA	Greater London Authority
LZC	Low and Zero-Carbon technologies
NCM	National Calculation Methodology
PV	Photovoltaics
SAP	Standard Assessment Procedure
SBEM	Simplified Building Energy Model
TER	Target Emission Rate
TFEE	Target Fabric Energy Efficiency
VRF	Variable Refrigerant Flow

APPENDIX 2. PLANNING POLICY AND DESIGN GUIDANCE

The Climate Change Act (2008)

Passed in November 2008, the Climate Change Act mandated that the UK would reduce emissions of six key greenhouse gases, including Carbon Dioxide, by 80% by 2050.

As a consequence, the reduction of carbon dioxide emissions is at the forefront of National, Regional and Local Planning Policy, along with continuing step changes in performance introduced by the Building Regulations Approved Document L (2013).

Approved Document L (2013)

This development is subject to the requirements of Approved Document L (2013). AD L 2013 represented an approximate reduction of 6% in the Target Emission Rate (Kg/CO_2/sqm per annum) over the requirements of Approved Document L (2010) for residential development and an aggregate 9% reduction for non-residential development. AD L (2013) also sees the introduction of a Fabric Energy Efficiency Target, a measure of heating demand (kW hrs/sqm per annum) to ensure new-build dwellings with low-carbon heating systems still meet satisfactory energy-efficiency standards.

National Planning Policy (2021)

The National Planning Policy Framework encourages Local Planning Authorities to *'support the transition to a low carbon future in a changing climate, taking full account of flood risk and costal change' (NPPF paragraph 152), 'whilst taking a proactive approach to mitigating and adapting to client change, taking into account the long-term implication for flood risk, costal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures'. (NPFF Paragraph 153).*

Paragraph 155, upholds the requirement for Local Plans to: *'To help increase the use and supply of renewable and low carbon energy and heat, plans should: a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts); b) consider identifying suitable areas of renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and c) identify opportunities for development to* *draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.'*

In paragraph 157, NPPF stipulates that local planning authorities should take account of the benefits of decentralised energy and passive design measures as a means of energy efficiency in new development: *'In determining planning applications, local planning authorities should expect new development to: a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the Applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.'*

The London Plan (2021)

Policy SI 2 Minimising greenhouse gas emissions

A. Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
   I. Be lean: use less energy and manage demand
   II. Be clean: exploit local energy resources and supply energy efficiently and cleanly
   III. Be green: maximise opportunities for renewable energy on-site
   IV. Be seen: monitor, verify and report on energy performance

B. Major development proposals should include a detailed energy strategy to demonstrate how the zero carbon target will be met within the framework of the energy hierarchy.

C. A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
   - through a cash in lieu contribution to the borough's carbon offset fund, or
   - off-site provided that an alternative proposal is identified, and delivery is certain.

D. Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually.

E. Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e., unregulated emissions.

F. Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce lifecycle carbon emissions.

Policy SI 3 Energy infrastructure

A. Boroughs and developers should engage at an early stage with relevant energy companies and bodies to establish the future energy and infrastructure requirements arising from largescale development proposals such as Opportunity Areas, Town Centres, other growth areas or clusters of significant new development.

B. Energy masterplans should be developed for large-scale development locations (such as those outlined in Part A and other opportunities) which establish the most effective energy supply options.

C. Development Plans should identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing infrastructure identify existing heating and cooling networks, identify proposed locations for future heating cooling networks and identify opportunities for expanding and interconnecting existing networks as well as establishing new networks.

D. Major development proposals within Heat Network Priority Areas should have a communal low temperature heating system. The heat source for the communal heating system should be selected in accordance with the following heating hierarchy:
a) connect to local existing or planned heat networks
b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)
c) use low-emission combined heat and power (CHP) (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)
d) use ultra-low NOx gas boilers

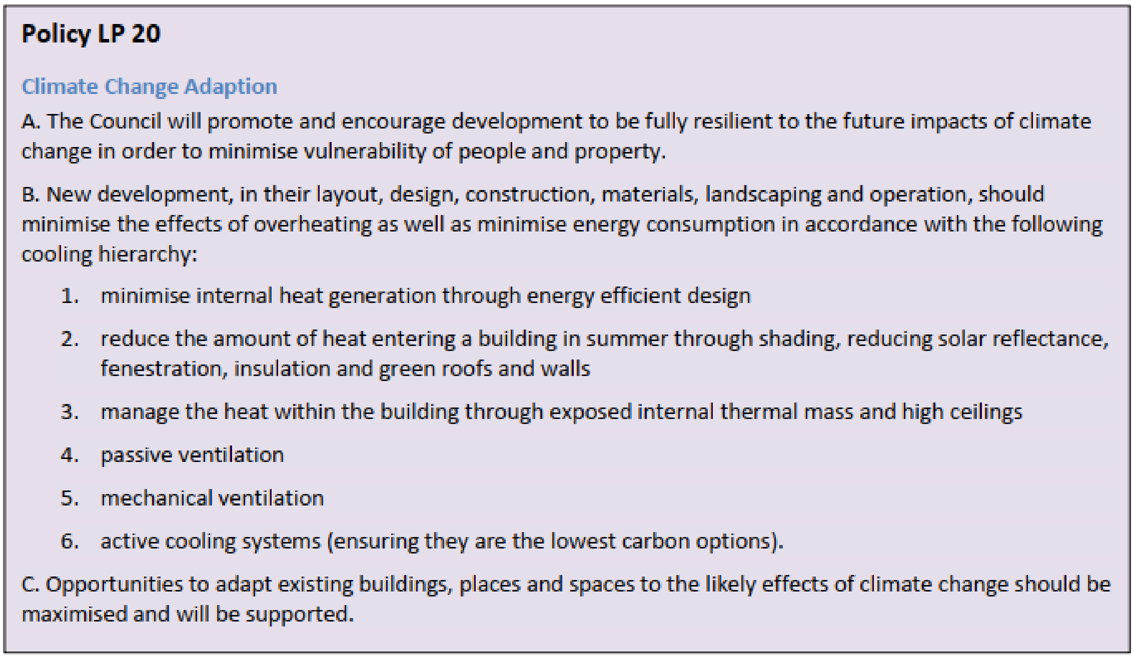
E. Heat networks should achieve good practice design and specification standards for primary, secondary and tertiary systems comparable to those set out in the CIBSE/ADE Code of Practice CP1 or equivalent.

Policy SI 4 Managing heat risk

A. Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B. Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:
   1. reduce the amount of heat entering a building through orientation, shading, high albedo
   2. materials, fenestration, insulation and the provision of green infrastructure
   3. minimise internal heat generation through energy efficient design
   4. manage the heat within the building through exposed internal thermal mass and high ceilings
   5. provide passive ventilation
   6. provide mechanical ventilation
   7. provide active cooling systems

London Borough of Richmond upon Thames: Local Plan (July 2018)



Policy LP 20

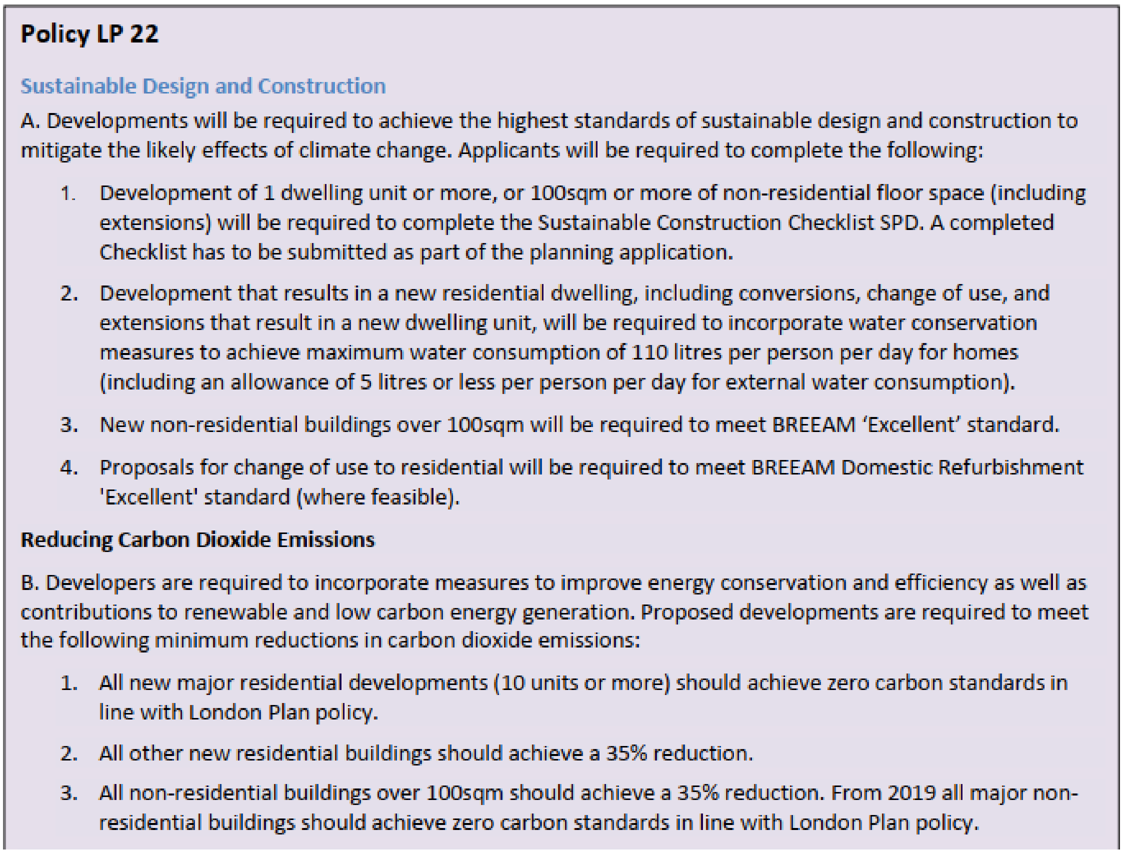
Climate Change Adaption

A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.

B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:

1. minimise internal heat generation through energy efficient design
2. reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls
3. manage the heat within the building through exposed internal thermal mass and high ceilings
4. passive ventilation
5. mechanical ventilation
6. active cooling systems (ensuring they are the lowest carbon options).

C. Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.



Policy LP 22

Sustainable Design and Construction

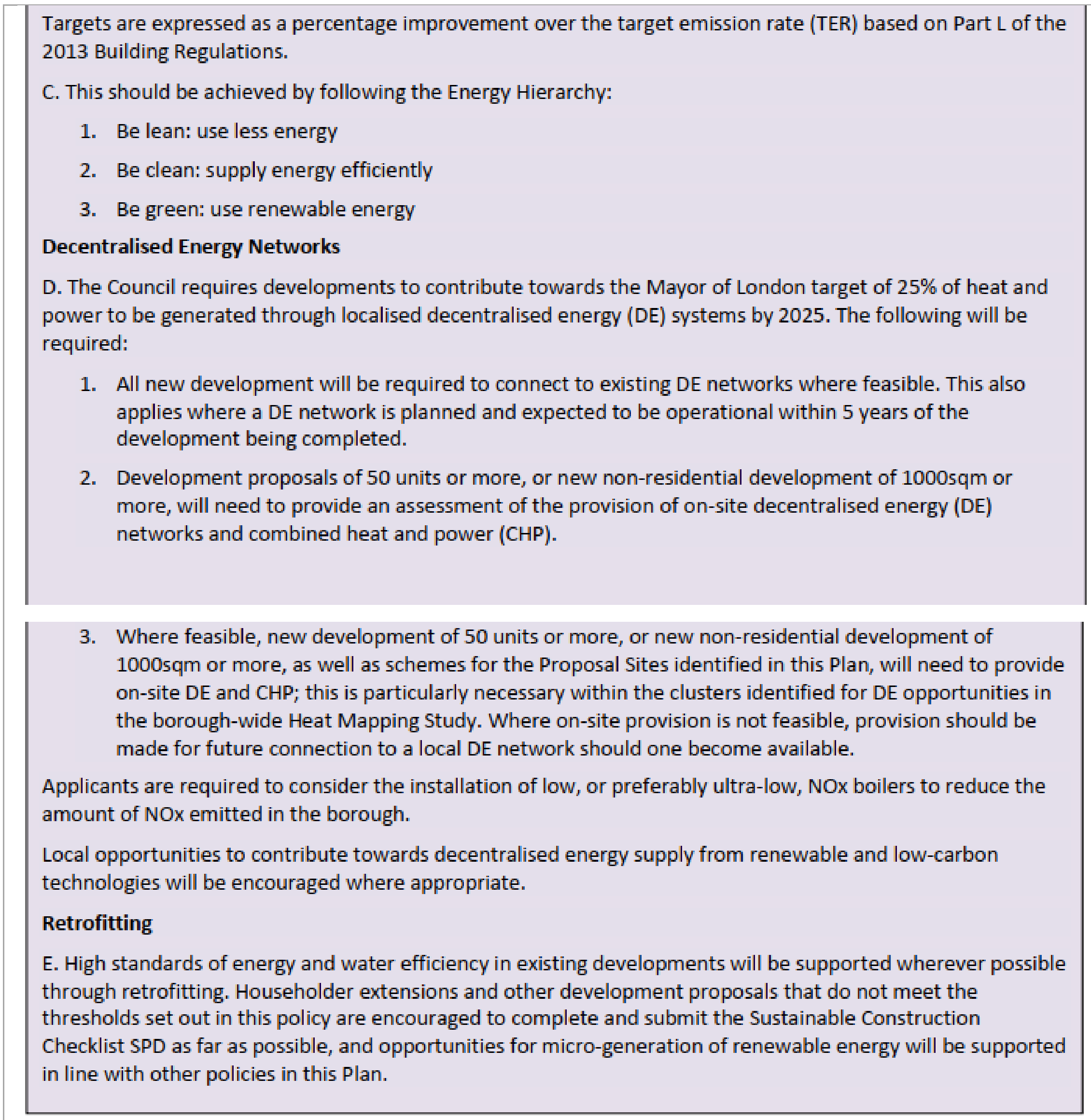
A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:

1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.
4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).

Reducing Carbon Dioxide Emissions

B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:

1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
2. All other new residential buildings should achieve a 35% reduction.
3. All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.



Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.

C. This should be achieved by following the Energy Hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Decentralised Energy Networks

D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:

1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.
2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).
3. Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available.

Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.

Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.

Retrofitting

E. High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to complete and submit the Sustainable Construction Checklist SPD as far as possible, and opportunities for micro-generation of renewable energy will be supported in line with other policies in this Plan.

The Housing Standards Review and implications on Local Planning Policy

On March 25th, 2015, the Government confirmed its policy to limit energy-efficiency targets that can be imposed on a development as a result of the Housing Standards Review. New developments should not be conditioned to achieve a reduction in Carbon Emissions exceeding a 19% improvement over the requirements of Approved Document L (2013) – the equivalent energy performance of a Code for Sustainable Homes Level 4 dwelling.

In addition, the Government confirmed that the Code for Sustainable Homes is no longer an applicable standard for planning permissions granted on or after March 26th, 2015.

APPENDIX 3: ENERGY ASSESSMENT RESULTS

GLA spreadsheet to be provided separately.

APPENDIX 4: SAMPLE SAP AND BRUKL REPORTS

Be Lean & Be Green sample TER and DER Worksheets for domestic, and BRUKLs for non-domestic areas to be provided separately.

APPENDIX 5: ASSESSMENT OF LOW- AND ZERO-CARBON TECHNOLOGIES

Wind	*The ability to generate electricity via a turbine or similar device which harnesses natural wind energy. This could be considered as an onsite solution to reducing carbon emissions (turbines included within the development), or offsite (investing financially into a nearby wind farm).*
Installation considerations	▪ Wind turbines come in a variety of sizes and shapes. Turbines of 1 Kw can be installed to single house and large-scale turbines of 1-2 MW can be installed on a development to generate electricity to multiple dwellings and other buildings. In both instances the electricity generated can be used on site or exported to the grid. Vertical- or horizontal-axis turbines are available. ▪ A roof-mounted 1 kW micro wind system costs up to £3,000. A 2.5 kW pole-mounted system costs between £9,900 and £19,000. A 6 kW pole-mounted system costs between £21,000 and £30,000 (taken from the Energy Saving Trust, TBC by supplier) ▪ Local average wind speed is a determining factor. A minimum average wind speed of 6 m/s is required. ▪ Noise considerations can be an issue dependent on density and build-up of the surrounding area. ▪ Buildings in the immediate area can disrupt wind speed and reduce performance of the system. ▪ Planning permission will be required along with suitable space to site the turbine, whether ground installed, or roof mounted.
Advantages	▪ Generation of clean electricity which can be exported to the grid or used onsite. ▪ Can benefit from the Feed in Tariff, reducing payback costs.
Disadvantages	▪ Planning restrictions and local climate often limit installation opportunities. ▪ Annual maintenance required.

	▪ High initial capital cost. It is usual for an investor to consider a series of turbines to make the investment financially sound.
Development feasibility ✗	▪ Installing a large turbine in an area such as this is not considered to be appropriate due to its appearance and physical impact on the built-up environment. Residents' and neighbours' concerns may include the look of the turbine, the hum of the generator and the possibility of stroboscopic shadowing from the blades on homes. ▪ Wind speed has been checked for the development scheme using the NOABL wind map: http://www.rensmart.com/Weather/BERR. The wind speed at ten metres for the development scheme is 4.6 metres per second (m/s) which is below the minimum of 5 m/s and threshold for technical viability. ▪ Typical payback times for a single turbine are expected to be greater than 15 years which means that the cost of installing and maintaining a single wind turbine is not considered a commercially-viable option.
Solar PV **Solar Thermal**	*The ability to generate energy (either electricity, hot water or a combination of the two) through harnessing natural solar energy. This could include the use of solar thermal panels, photovoltaic (PV) panels, or a combined solution. PV panels, similarly, to turbines, can be considered both on and offsite.* Solar Photovoltaics convert solar radiation into electricity which can be used on site or exported to the national grid. Solar Thermal generates domestic hot water from the sun's radiation. Glycol circulates within either flat plate or evacuated tube panels, absorbing heat from the sun, and transferring this energy to a water cylinder. A well-designed solar thermal system will account for 50-60% of a dwelling's annual hot water demand. Sizing the system to meet a higher demand will lead to excess heat generation in the summer months and overheating of the system.

Installation considerations	▪ Operate most efficiently on a south-facing sloping roof (between 30- and 45-degree pitch.) ▪ Shading must be minimal (one shaded panel can impact the output of the rest of the array.) ▪ Panels must not be laid horizontally on a flat roof as they will not self-clean. Panels will therefore need to be installed at an angle and with appropriate space between them, to avoid over-shading. ▪ Large arrays may require upgrades to substations if exporting electricity to the grid. ▪ Local planning requirements may restrict installation of panels on certain elevations. ▪ Installation must take into account pitch and fall of the roof, along with any additional plant on the roof to ensure there is sufficient room. ▪ The average domestic solar PV system is 4kWp and costs £5,000 - £8,000 (including VAT at 5 per cent) - (taken from the Energy Saving Trust).
Advantages	▪ Relatively straightforward installation, connection to landlord’s supply and metering. ▪ Linear improvement in performance as more panels are installed. ▪ Installation costs are continually reducing. ▪ Can benefit from the Feed in Tariff to improve financial payback.
Disadvantages	▪ Less appropriate for high-rise developments, due to lack of roof space in relation to total floor area. ▪ With Solar Thermal, performance is limited by the hot water demand of the building – system oversizing will lead to overheating.

Development feasibility

✓

- The suitability of Solar panels has been considered for this Development and are concluded as a technically-viable option.
- There are potential areas of roof space suitable for the positioning of unshaded Solar PV arrays.
- The Development is not on land, which is protected or listed, so it is considered that Solar panels would not have a negative impact on the local historical environment or the aesthetics of the area.

Aerothermal

The transfer of latent heat in the atmosphere to a compressed refrigerant gas to warm the water in a heating system. This includes air to water heat pumps and air conditioning systems.

Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water.

They can feed either low-temperature radiators or underfloor heating and often have electric immersion heater back-up for the winter months.

Installation considerations

- ASHPs operate effectively in buildings with a low energy demand, as they emit low levels of energy suitable for maintaining rather than dramatically increasing internal temperatures. It is therefore vital that the dwelling has a low heating demand to ensure the system can provide appropriate space-heating capability.

	▪ Underfloor heating will give the best performance, but oversized radiators can also be used. ▪ Immersion heater back-up required to ensure appropriate Domestic Hot Water (DHW) temperature in winter months. ▪ Noise from the external unit can limit areas for installation. ▪ £7,000-£11,000 per dwelling (taken from the Energy Saving Trust).
Advantages	▪ Air source systems are a good alternative solution to providing heating and hot water to well-insulated, low heat loss dwellings. ▪ They require additional space when compared to a gas boiler. Space for an external unit is needed, as is space for the hot water cylinder and internal pump. ▪ Heat pumps are generally quiet to run, however if a collection of pumps were used, this could generate a noticeable hum while in operation. ▪ Running costs between heat pumps and modern gas boilers are comparable.
Disadvantages	▪ Residents need to be made aware of the most efficient way of using a heat pump as the low flow rates used by such a system means that room temperature cannot be changed as reactively as a conventional gas or oil boiler system. ▪ Will not perform well in homes that are left unoccupied and unheated for a long period of time. ▪ Back-up immersion heating can drastically increase running costs. ▪ Noise and aesthetic considerations limit installation opportunities.
Development feasibility ✓	▪ ASHPs are considered a viable option for this development scheme and shall be utilised as part of a communal heating network which works well with the reduced energy demand, as achieved through passive design principles.

Geothermal	*The transfer of latent heat from the ground to a compressed refrigerant gas to warm the water in a heating system. This includes ground source heat pumps. Heat can be collected through the use of either horizontally laid or vertically installed coils.* Ground Source Heat Pumps (GSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the ground) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the ground, either through coils or in bore holes and piles, circulating a mix of water and antifreeze to extract energy from the ground, where the year-round temperature is relatively consistent (approx. 10℃ at 4 metres depth). This leads to a reliable source of heat for the building. Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for GSHPs tend to be higher than those of ASHPs.
Installation considerations	▪ Require appropriate ground conditions to sink piles/bore holes or excavate for coils (which also require a large area of land.) ▪ Decision between coils or piles can lead to significant extra cost. ▪ Need to consider whether low temperature output is fed through underfloor heating (most efficient) or oversized radiators. ▪ Similar to ASHPs, perform best in well-insulated buildings with a low heating demand. ▪ Electric immersion heater required for winter use. ▪ £11,000-£15,000 per dwelling dependent on the size of the system (taken from the Energy Saving Trust).
Advantages	▪ Perform well in well-insulated buildings, with limited heating demand. ▪ More efficient than ASHPs.

Disadvantages	▪ The coils can be damaged by natural earthworks and by intensive gardening practices – occupants would need to be aware of the location of the coils for this system, and how to operate the system efficiently. Coils may also be damaged within the dwelling where the circuit is connected to the internal unit. ▪ Will not perform well in buildings that are left unoccupied and unheated for a long period of time. ▪ Back up immersion heating can drastically increase running costs. ▪ Large area of ground needed for coil installation.
Development feasibility ✗	▪ GSHPs are not considered a viable option for this development scheme as they conflict with the preferred option of ASHP electric heating which works well with the reduced energy demand, as achieved through passive design principles.

Water Source Heat Pumps	*The transfer of latent heat from a local water source to a compressed refrigerant gas to warm the water in a heating system. This includes water source heat pumps. Heat can be collected through the use of either horizontally laid or vertically installed coils.* Water Source Heat Pumps (WSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the water) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the water source, circulating a mix of water and antifreeze to extract energy from the water, where the year-round temperature is relatively consistent (approx. 10℃ below surface). This leads to a reliable source of heat for the building. Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for WSHPs tend to be higher than those of ASHPs.

Installation considerations	▪ Require a reliable water source near to the site. ▪ Need to consider affect on the water course. ▪ Need to consider whether low temperature output is fed through underfloor heating (most efficient) or oversized radiators. ▪ Similar to ASHPs, perform best in well-insulated buildings with a low heating demand. ▪ Electric immersion heater required for winter use. ▪ £11,000-£15,000 per dwelling dependent on the size of the system (taken from the Energy Saving Trust).
Advantages	▪ Perform well in well-insulated buildings, with limited heating demand. ▪ More efficient than ASHPs.
Disadvantages	▪ The coils can be damaged by high water flow or low water levels– occupants would need to be aware of the location of the coils for this system, and how to operate the system efficiently. Coils may also be damaged within the dwelling where the circuit is connected to the internal unit. ▪ Will not perform well in buildings that are left unoccupied and unheated for a long period of time. ▪ Back up immersion heating can drastically increase running costs. ▪ Large area of water needed for coil installation.
Development feasibility ✗	▪ WSHPs are not considered a viable option for this development scheme as they conflict with the preferred option of ASHP electric heating which works well with the reduced energy demand, as achieved through passive design principles.

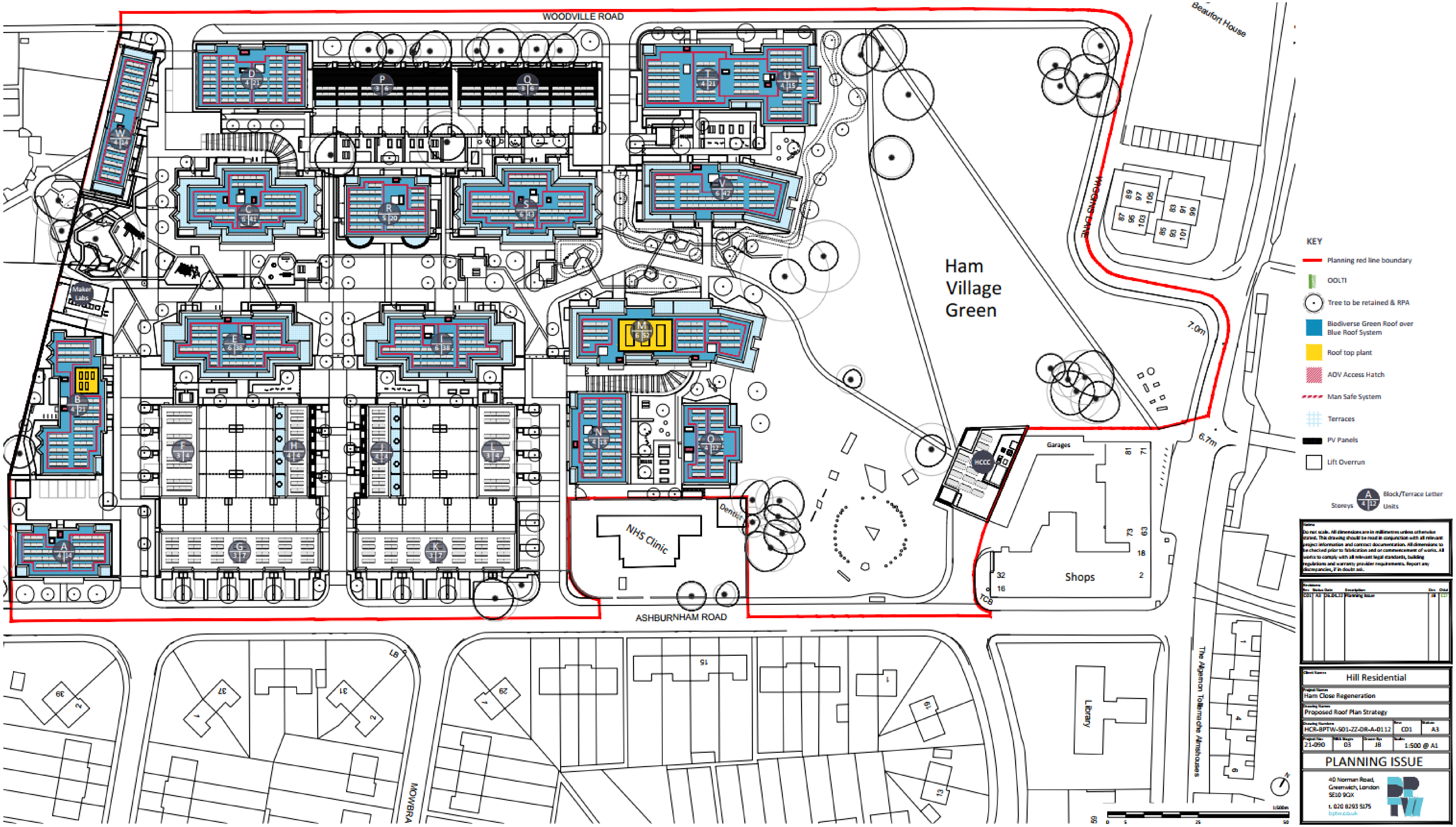
Biomass	*Providing a heating system fuelled by plant based materials such as wood, crops, or food waste.*

	Biomass boilers generate heat for space heating and domestic hot water through the combustion of biofuels, such as woodchip, wood pellets or potentially biofuel or bio diesel. Biomass is considered to be virtually zero carbon. They can be used on an individual scale or for multiple dwellings as part of a district-heating network. A back-up heat source should be provided as consistent delivery of fuel is necessary for continued operation.
Installation considerations	▪ Biomass boilers are larger than conventional gas-fired boilers and also require what can be significant storage space for the fuel source. This needs to be considered at planning stage to ensure an appropriate plant room can be provided. ▪ Flue required to expel exhaust gases – design needs to be in line with the requirements of the Building Regulations. ▪ Need to consider whether fuel deliveries will be reliable and consistent to the location of the site (especially relevant in rural areas) and whether the plant room can be easily accessed by the delivery vehicle. ▪ £9,000-£21,000 per dwelling dependent on size (taken from Energy Saving Trust).
Advantages	▪ Considerable reduction in CO_2 emissions.
Disadvantages	▪ Limited reduction in running costs compared to A-rated gas boilers, but at a substantially higher up-front cost. ▪ Plant room space required for boiler and storage. ▪ Dependent on consistent delivery of fuel. ▪ Ongoing maintenance costs (need to be cleaned regularly to remove ash.)
Development feasibility ✗	▪ Biomass is not considered a technically-viable option for the development scheme. The primary reason for this is down to the development's location within the context of London and the negative environmental impact of high levels of NOx gases that are emitted from biomass boilers and the subsequent impact on

local air quality. This is contrary to planning policies for air quality in London.

- There are also concerns regarding a sustainable supply of biomass to the site.
- The capital installation cost would be high which leads us to the conclusion that biomass would not be a commercially-viable option for this development scheme.

APPENDIX 6: INDICATIVE PV LAYOUT DRAWING



Do not scale. All dimensions are in millimetres unless otherwise stated. This drawing should be read in conjunction with all relevant project information and contract documentation. All dimensions to be checked prior to fabrication and or commencement of works. All works to comply with all relevant legal standards, building regulations and warranty provider requirements. Report any discrepancies, if in doubt ask.

Rev	Status	Date	Description	Drn	Chkd
C01	A3	06.04.22	Planning Issue	JB	CD

Client Name: Hill Residential
Project Name: Ham Close Regeneration
Drawing Name: Proposed Roof Plan Strategy
Drawing Number: HCR-BPTW-S01-ZZ-DR-A-0112
Rev: C01
Status: A3
Project No: 21-090
RIBA Stage: 03
Drawn By: JB
Scale: 1:500 @ A1

PLANNING ISSUE

40 Norman Road,
Greenwich, London
SE10 9QX
t. 020 8293 5175
bptw.co.uk

Figure 6 - Proposed Roof Plan showing indicative PV layout (BPTW drawing HCR-BPTW-S01-ZZ-DR-A-0112)

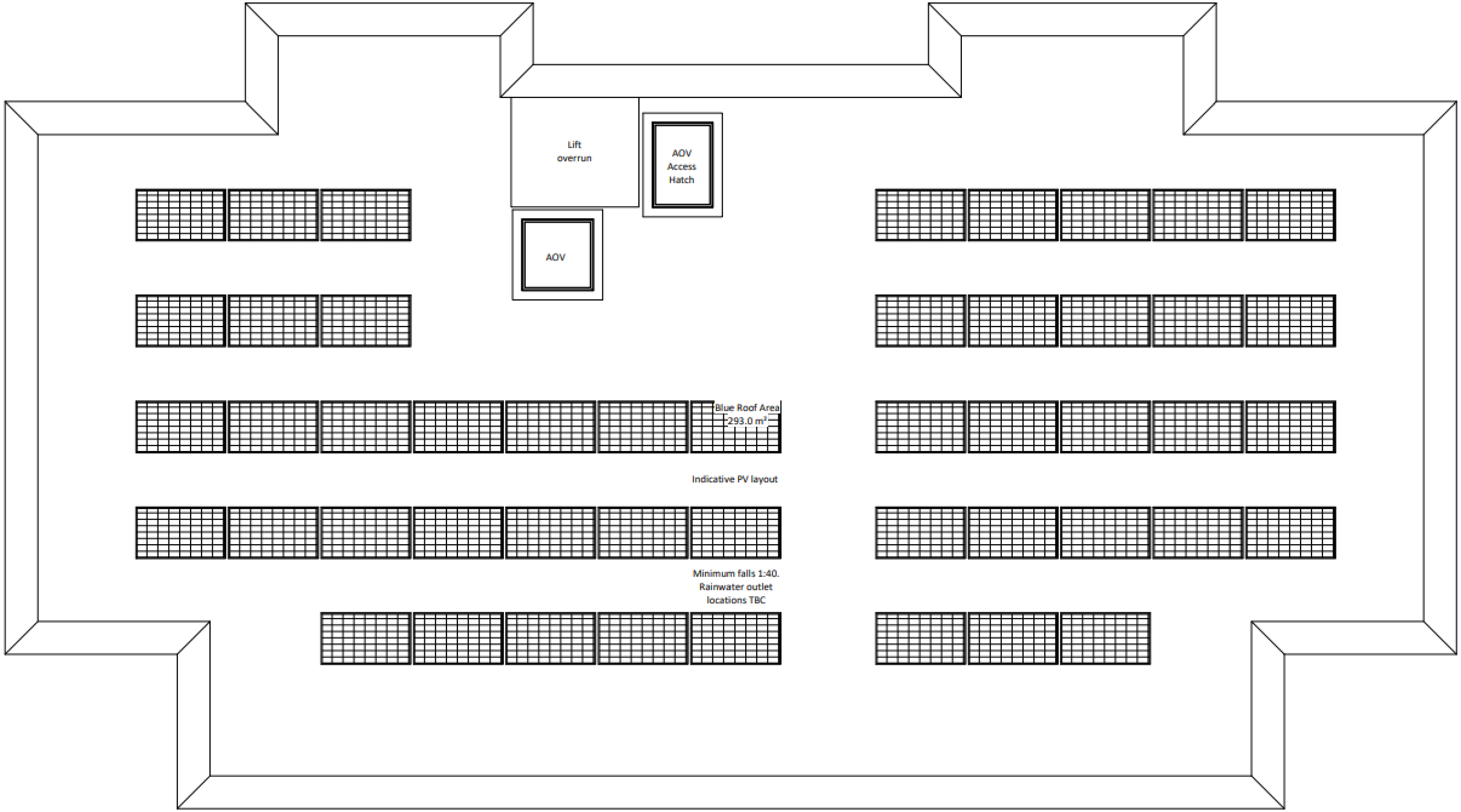


Figure 7 - Block A Roof Layout

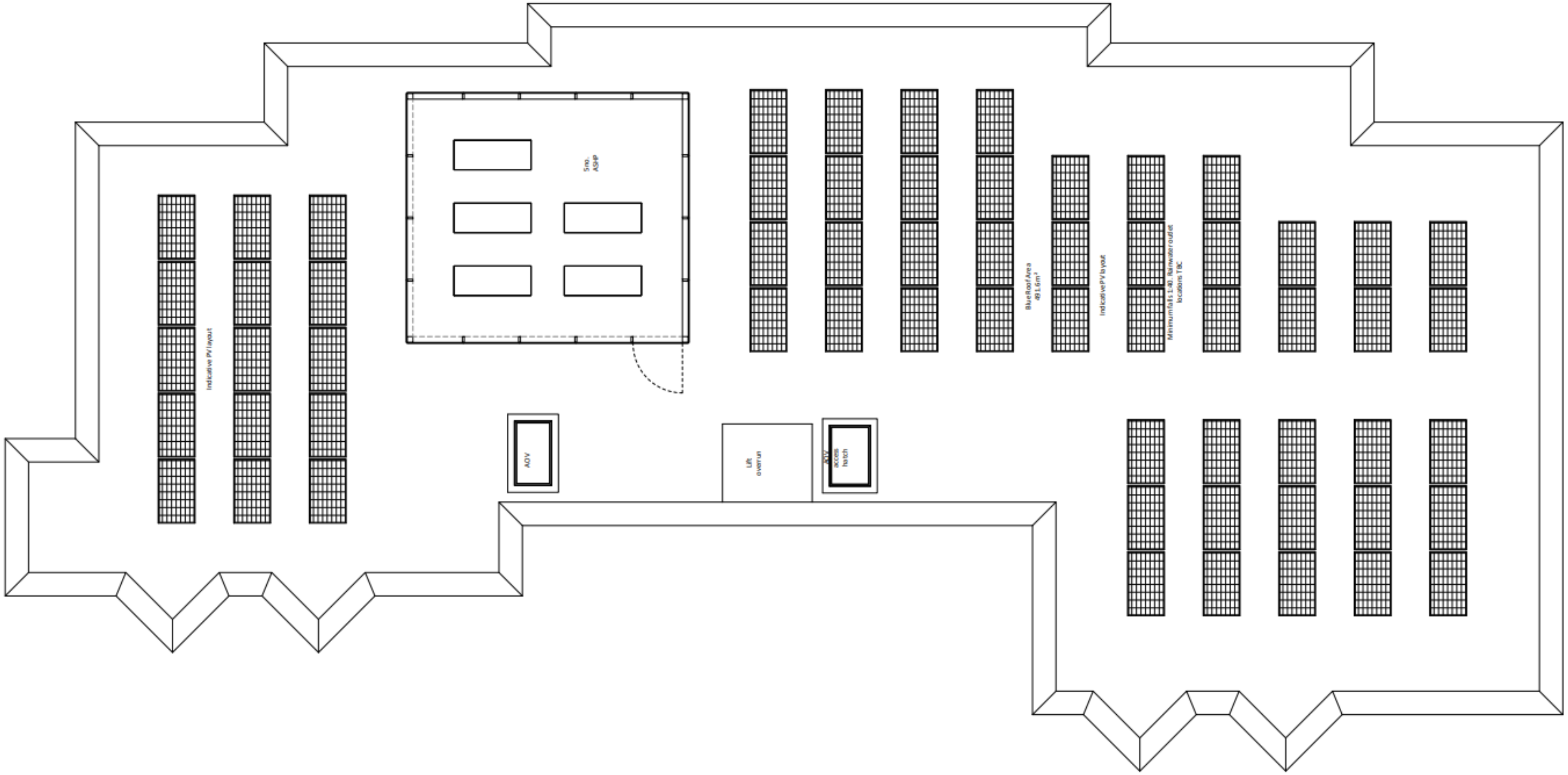


Figure 8 - Block B Roof Layout

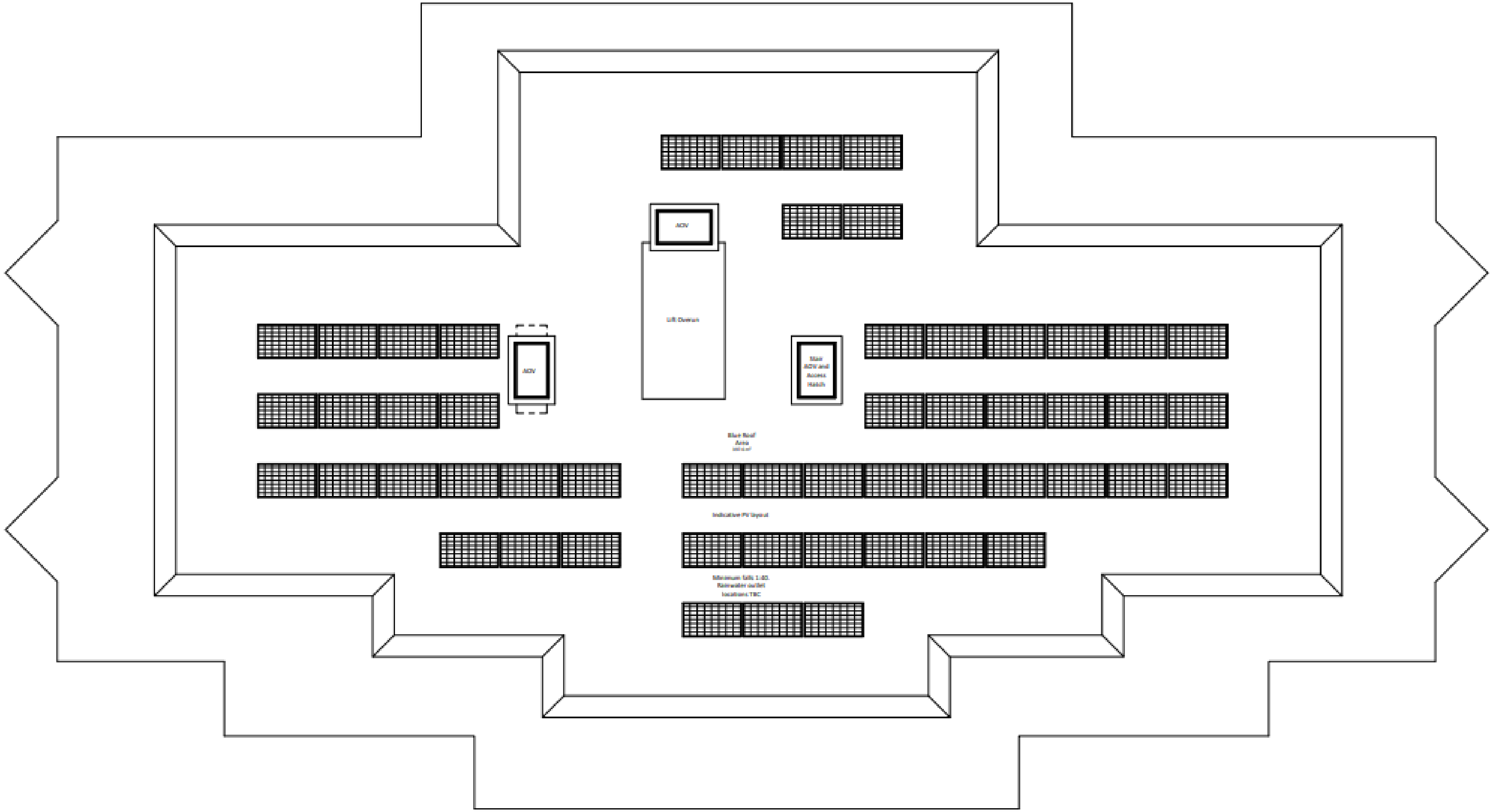


Figure 9 - Block C Roof Layout

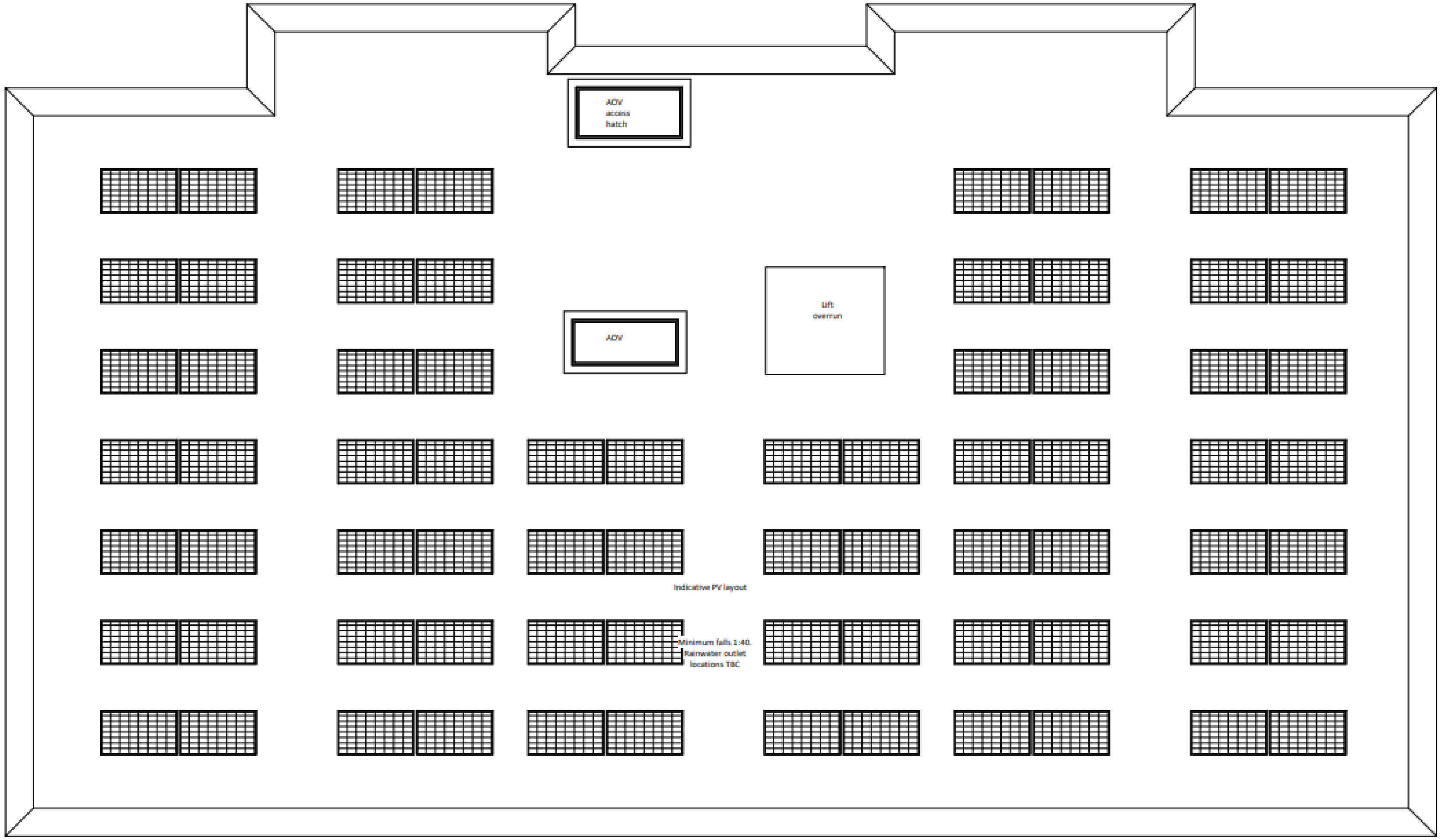


Figure 10 - Block D Roof Layout

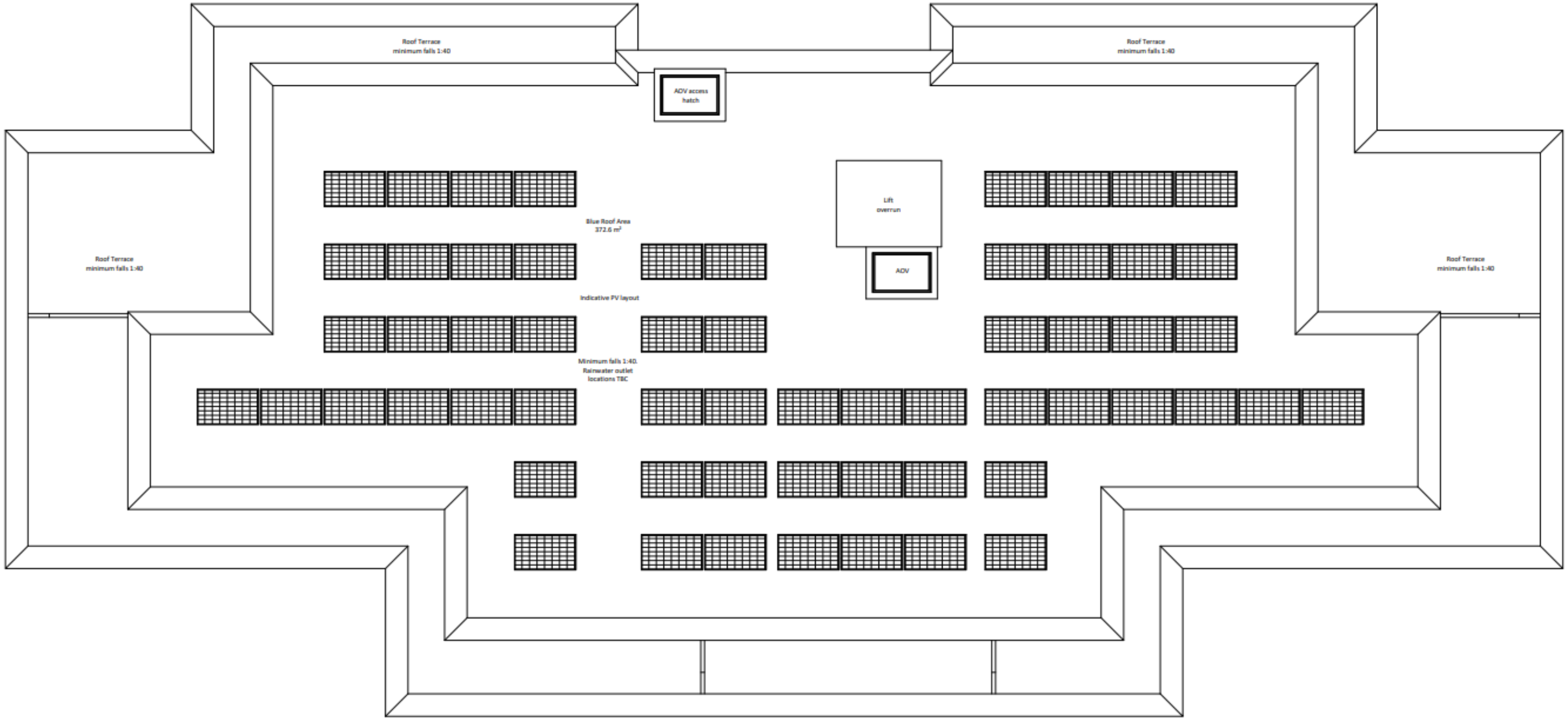


Figure 11 - Block E Roof Layout

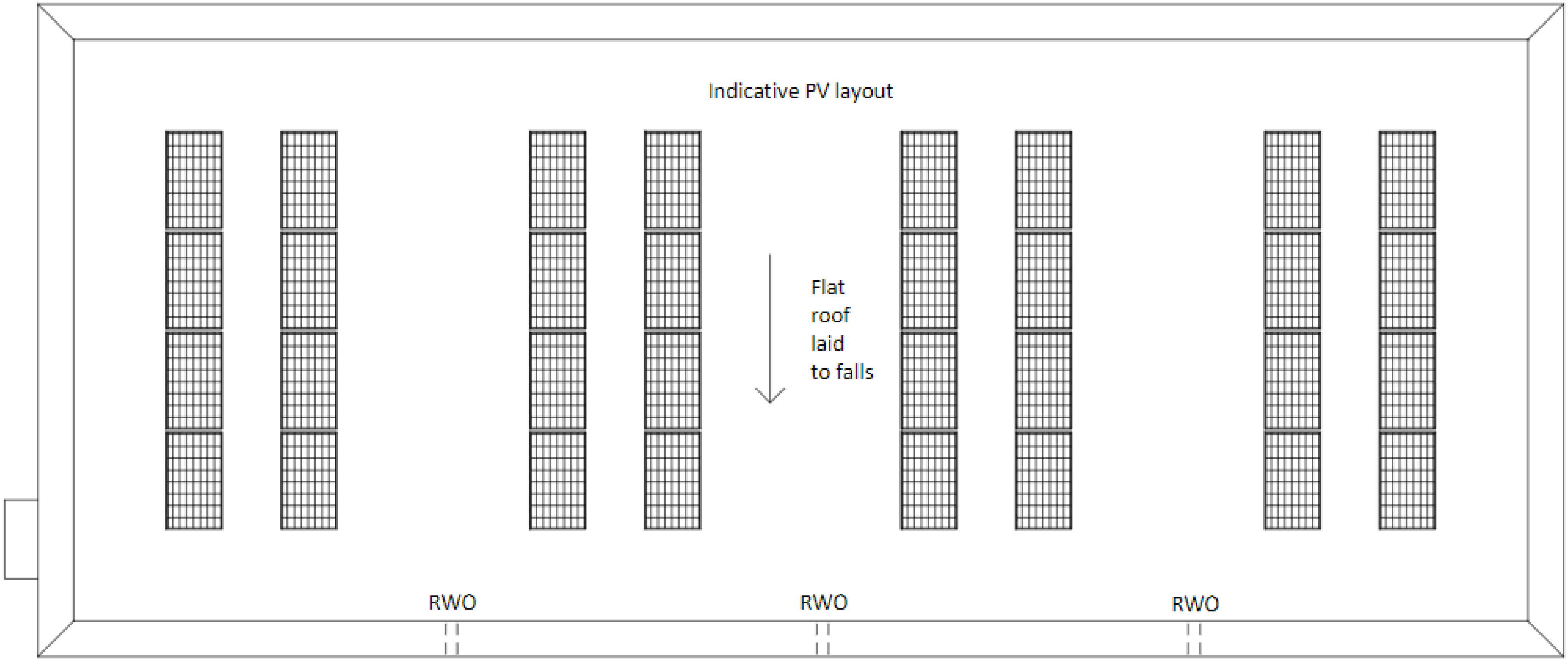


Figure 12 - Block F and L Roof Layout

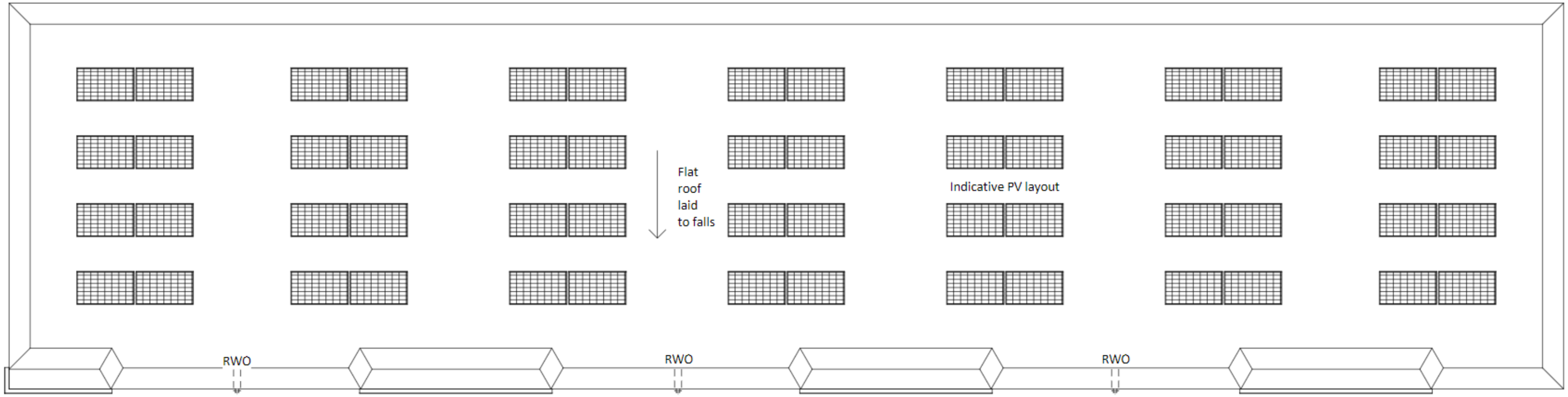


Figure 13 - Blocks G and K Roof Layout

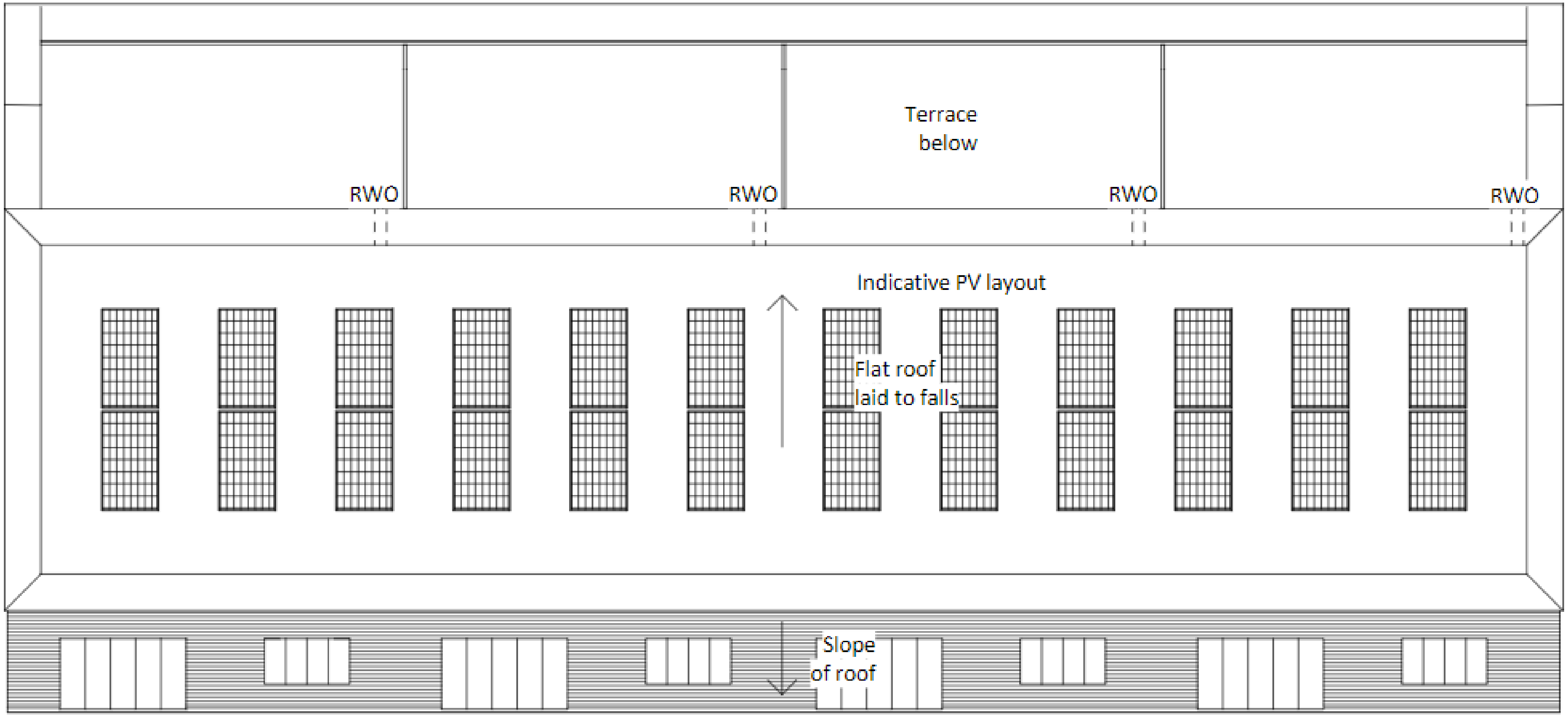


Figure 14 - Block H and J Roof Layout

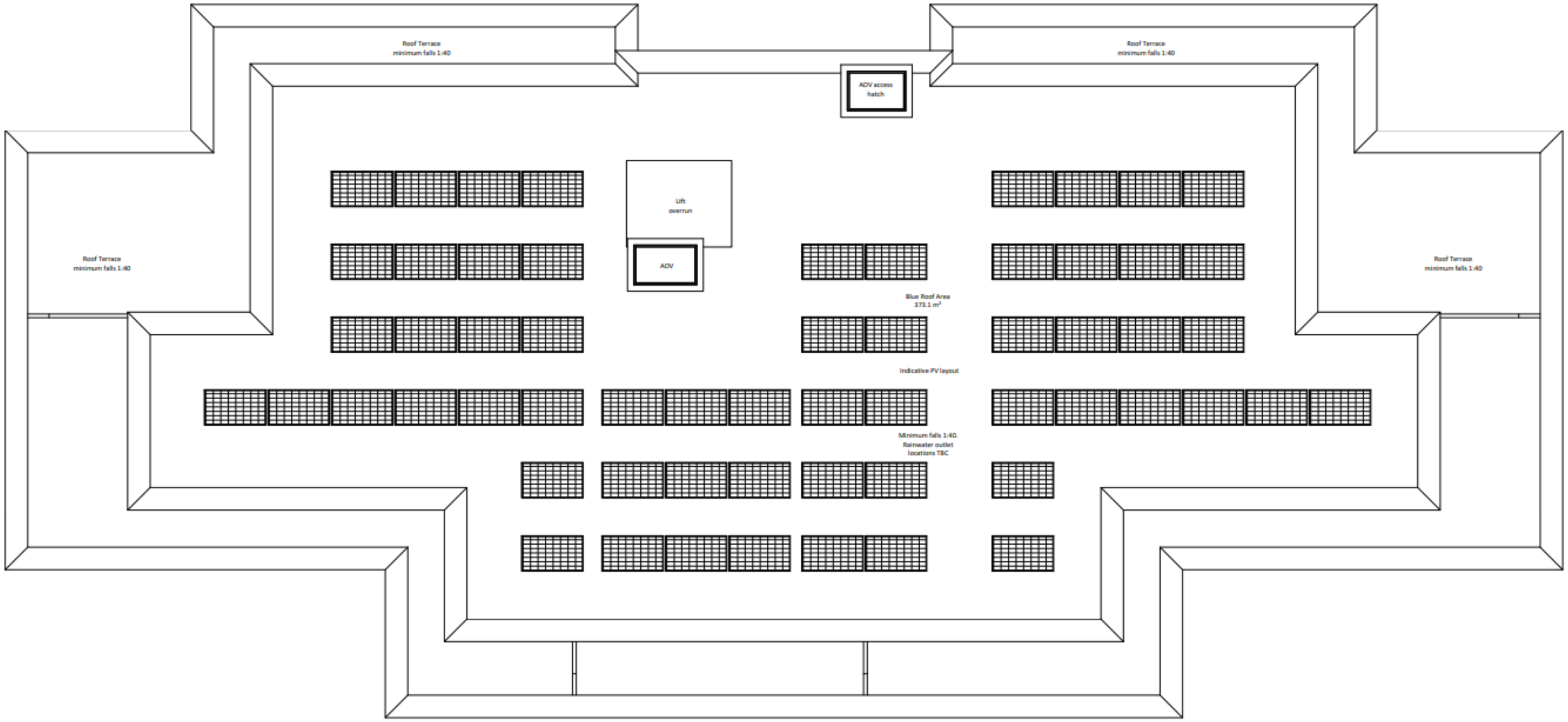


Figure 15 - Block I Roof Layout

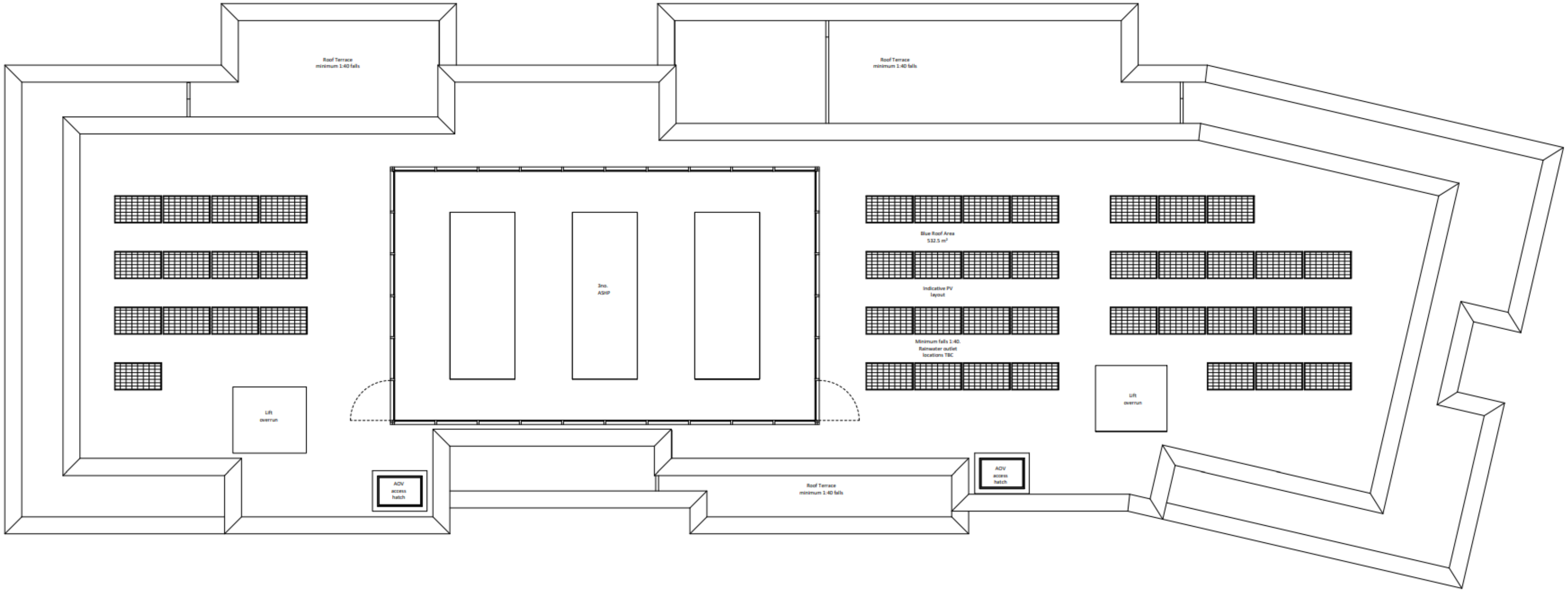


Figure 16 - Block M Roof Layout

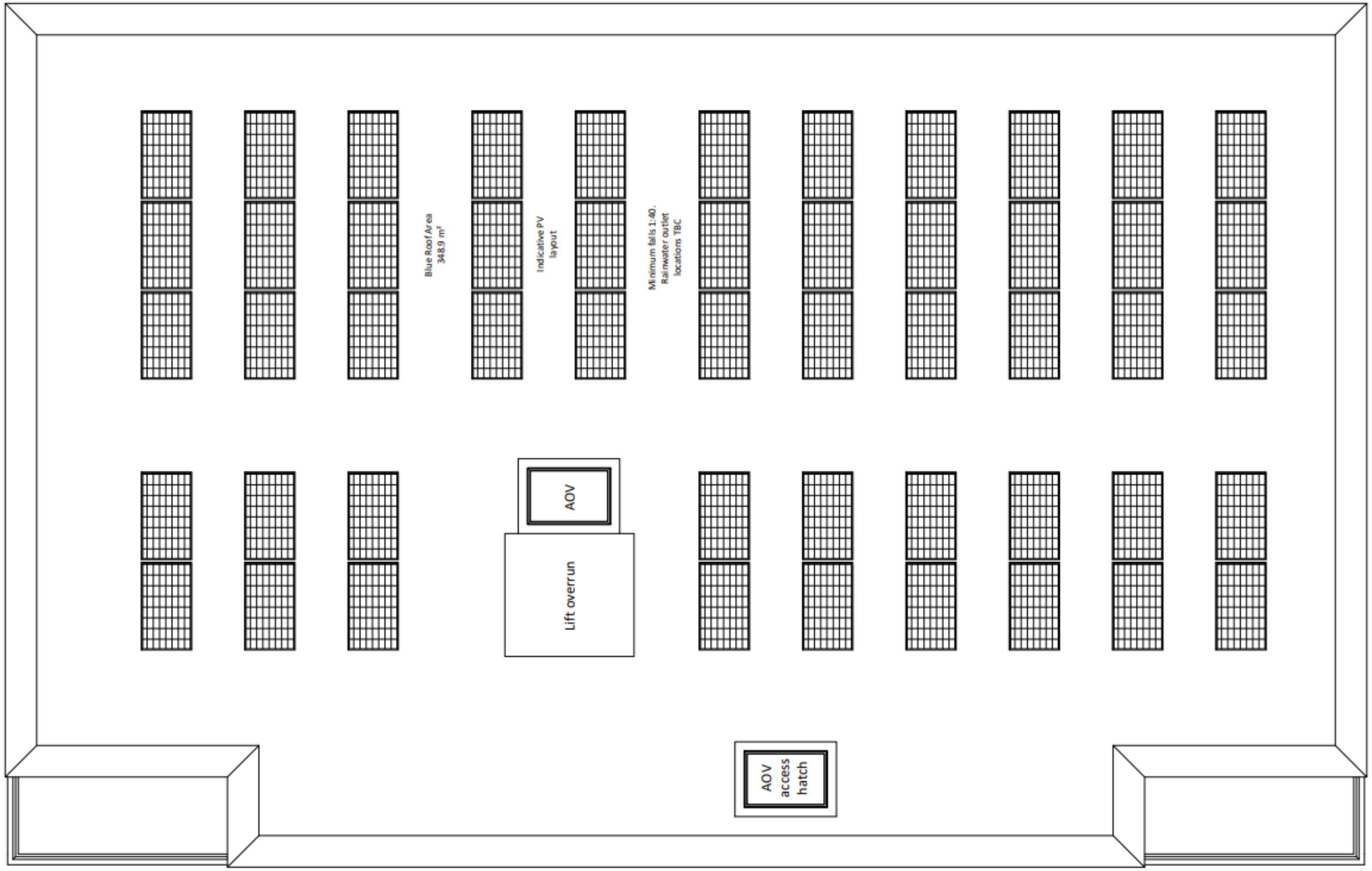


Figure 17 - Block N Roof Layout

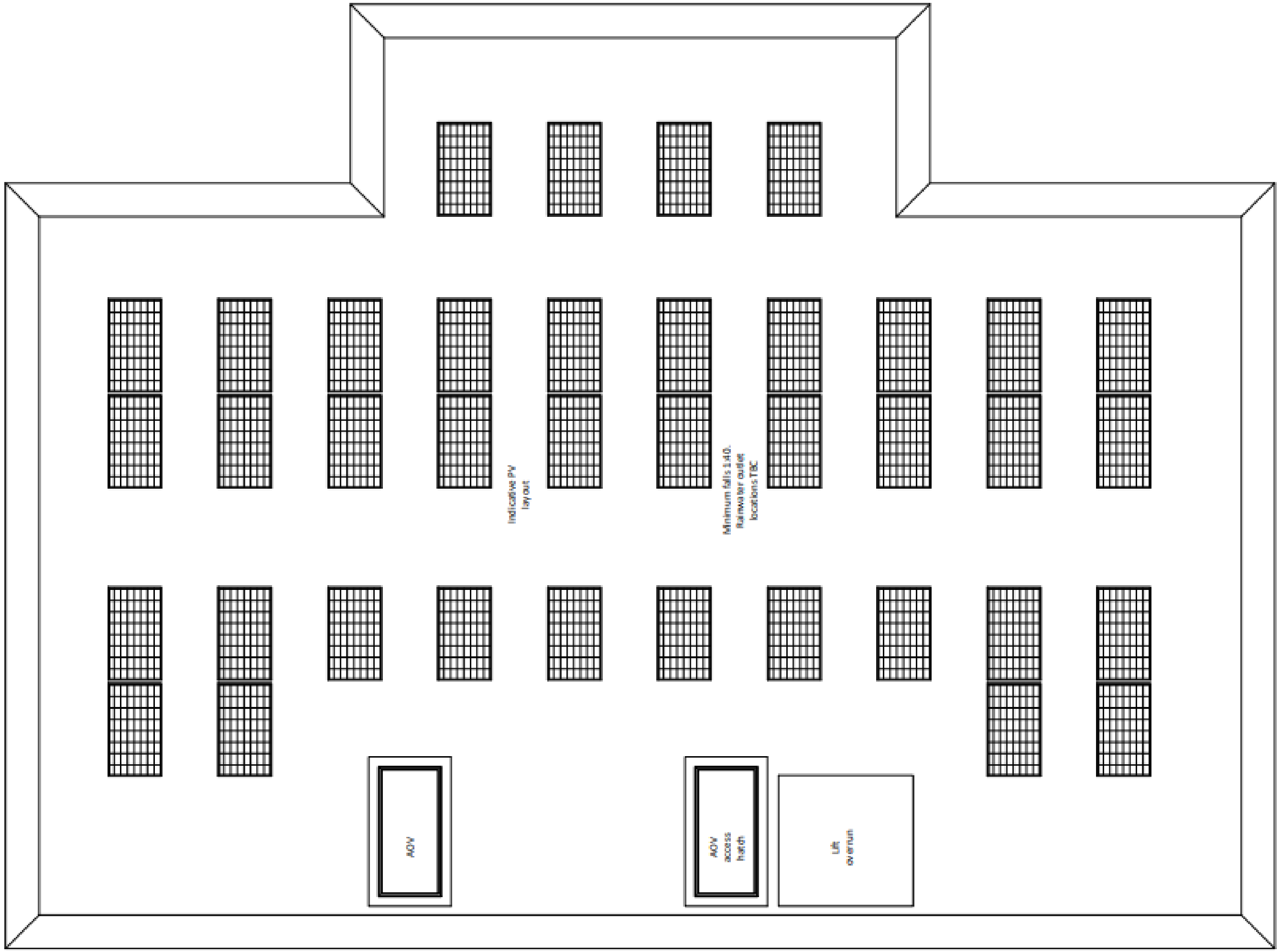


Figure 18 - Block O Roof Layout

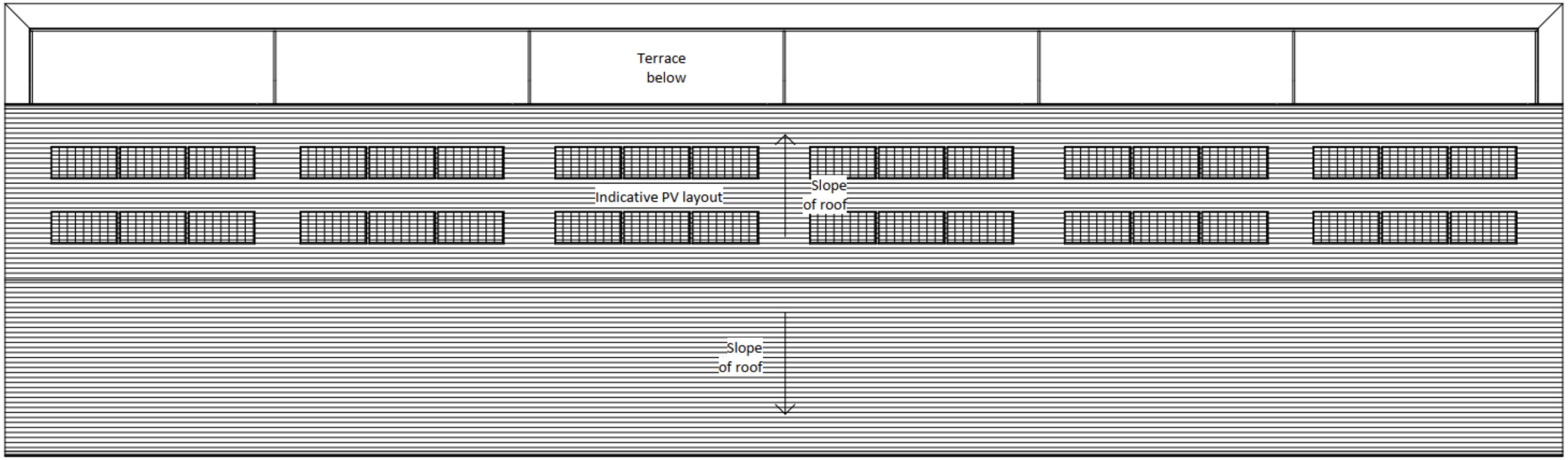


Figure 19 - Block P and Q Roof Layout

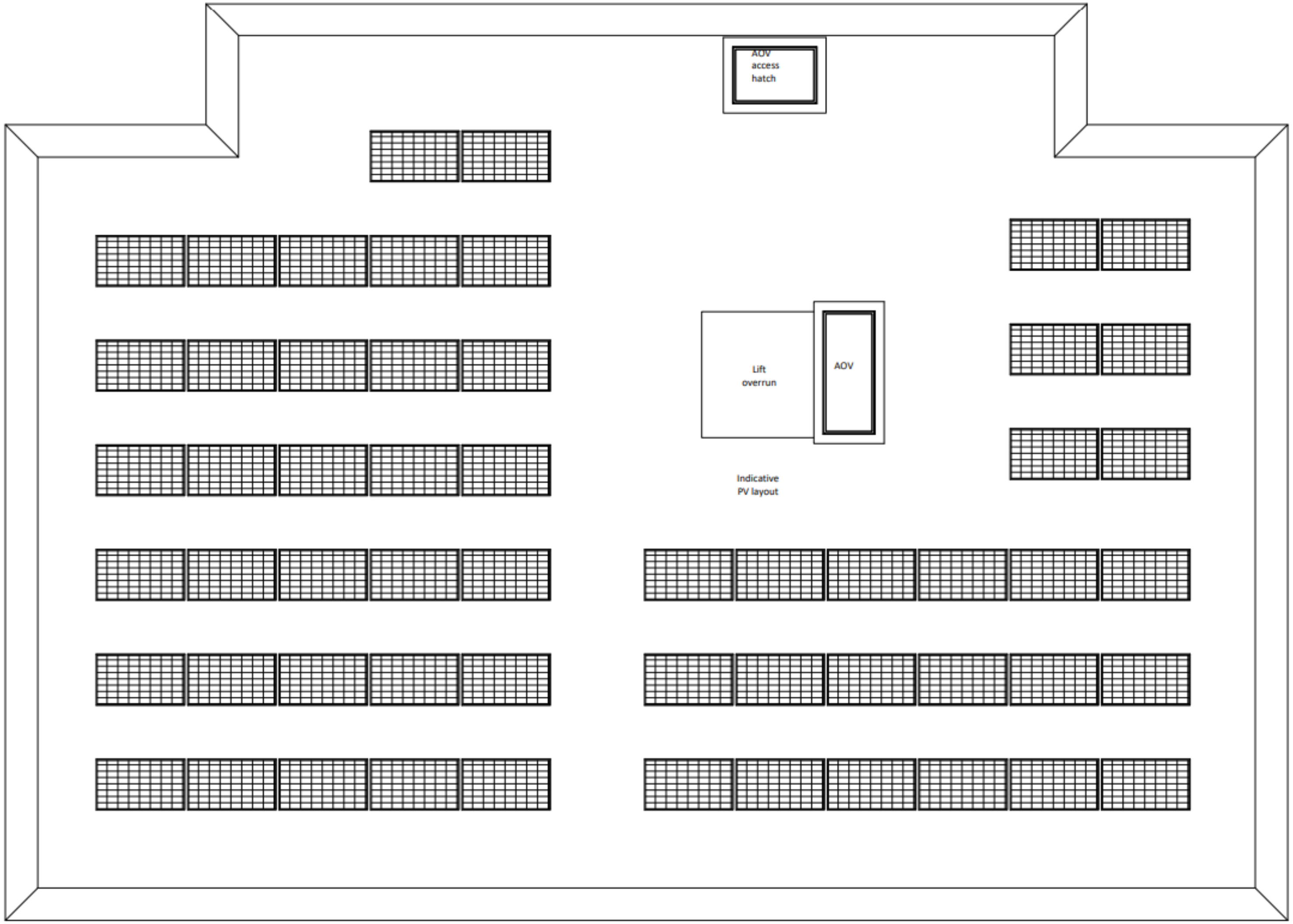


Figure 20 - Block R Roof Layout

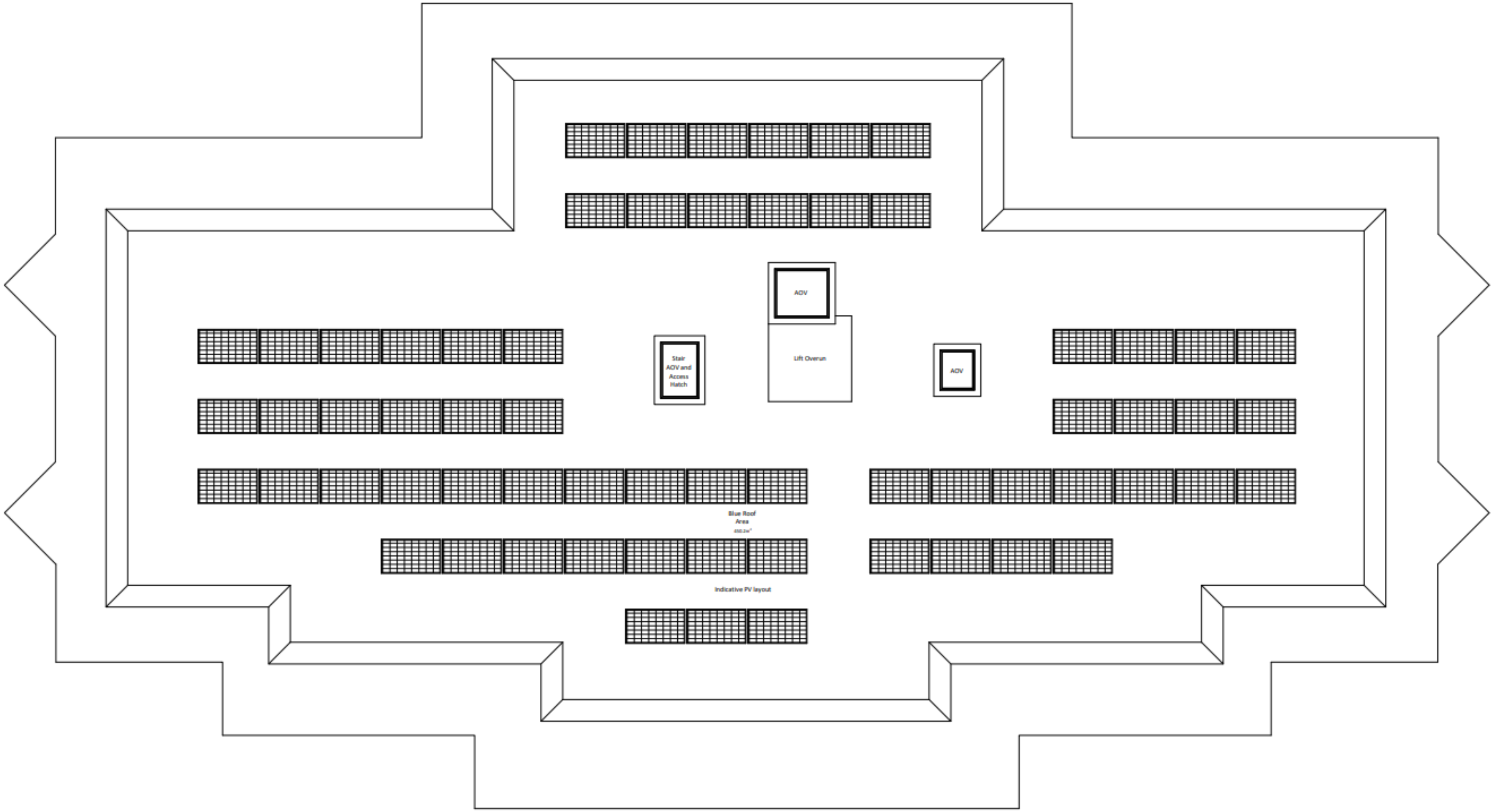


Figure 21 - Block S Roof Layout

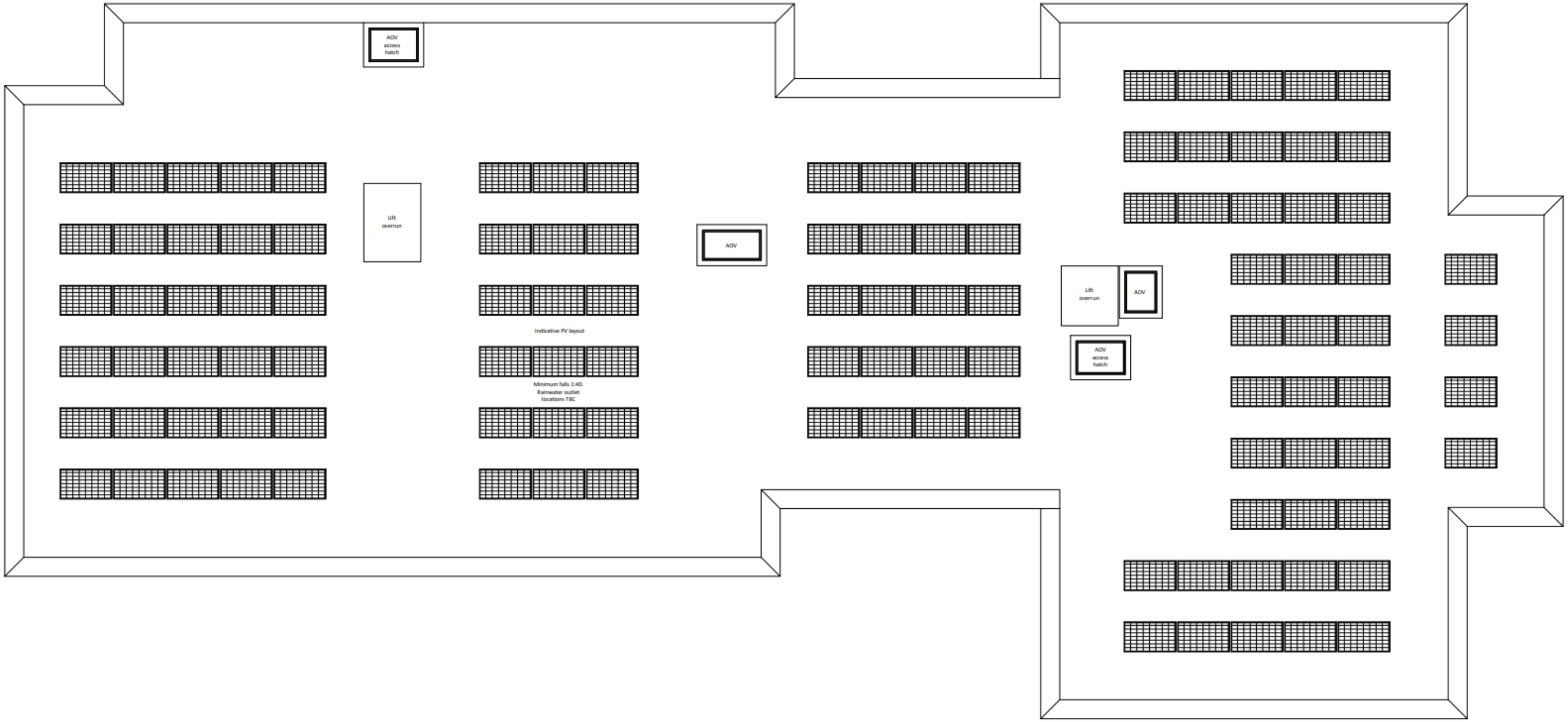


Figure 22 - Block T and U Roof Layout

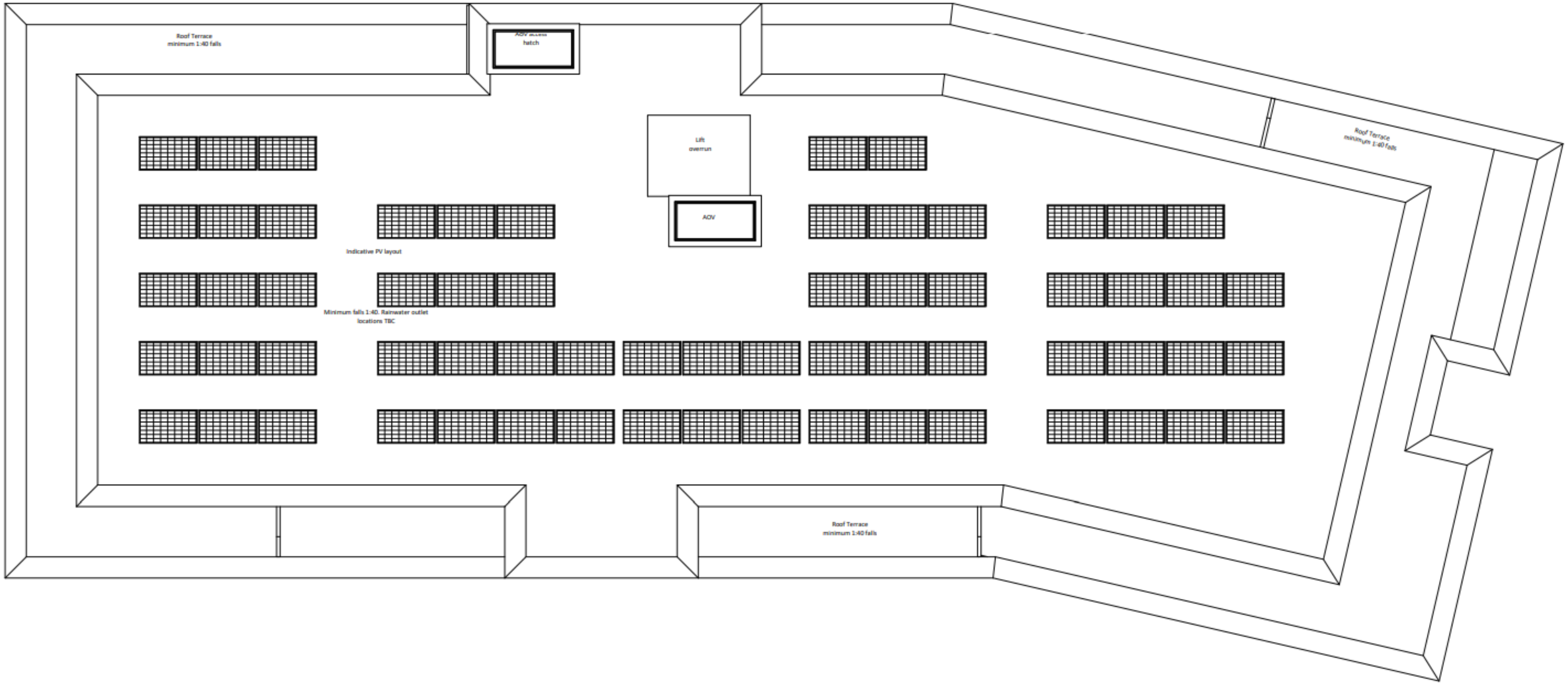


Figure 23 - Block V Roof Layout

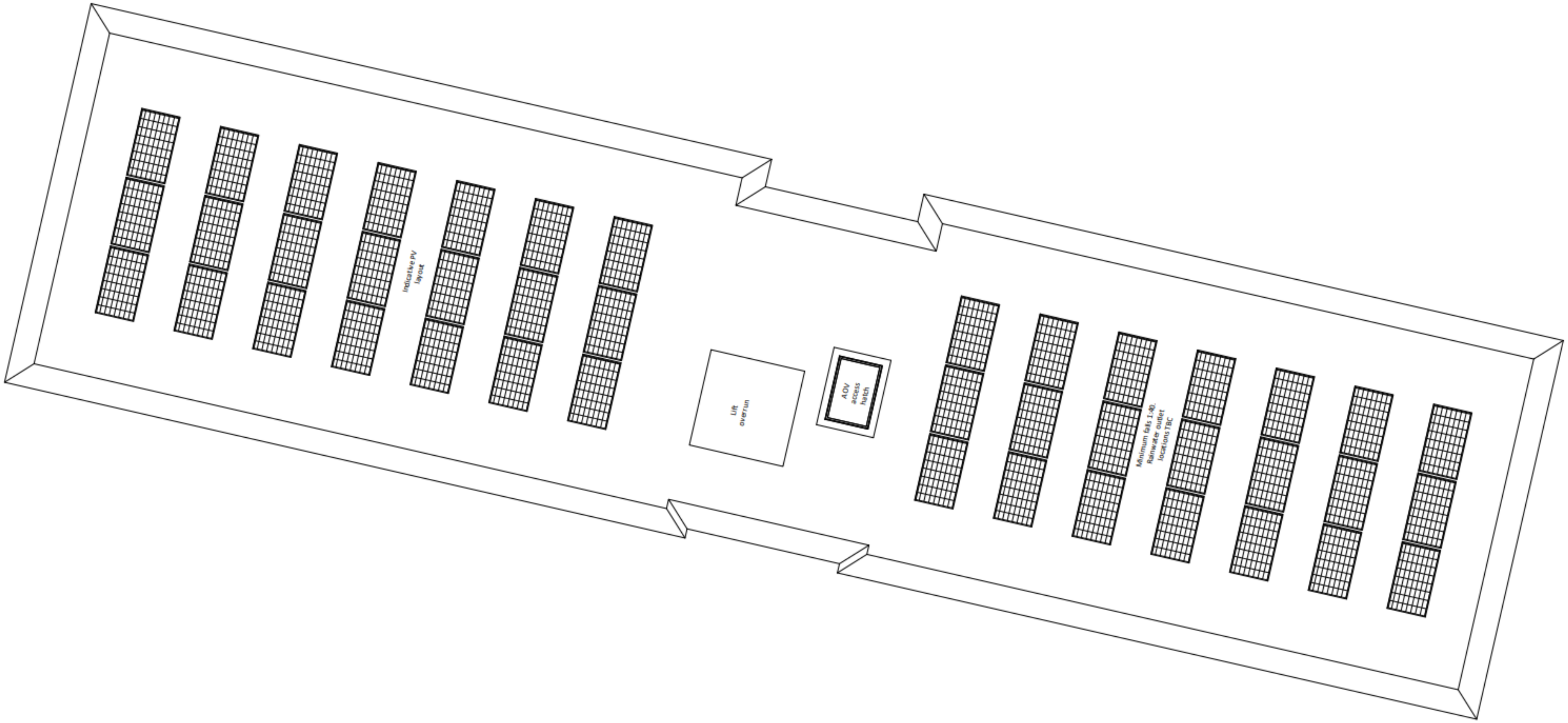


Figure 24 - Block W Roof Layout

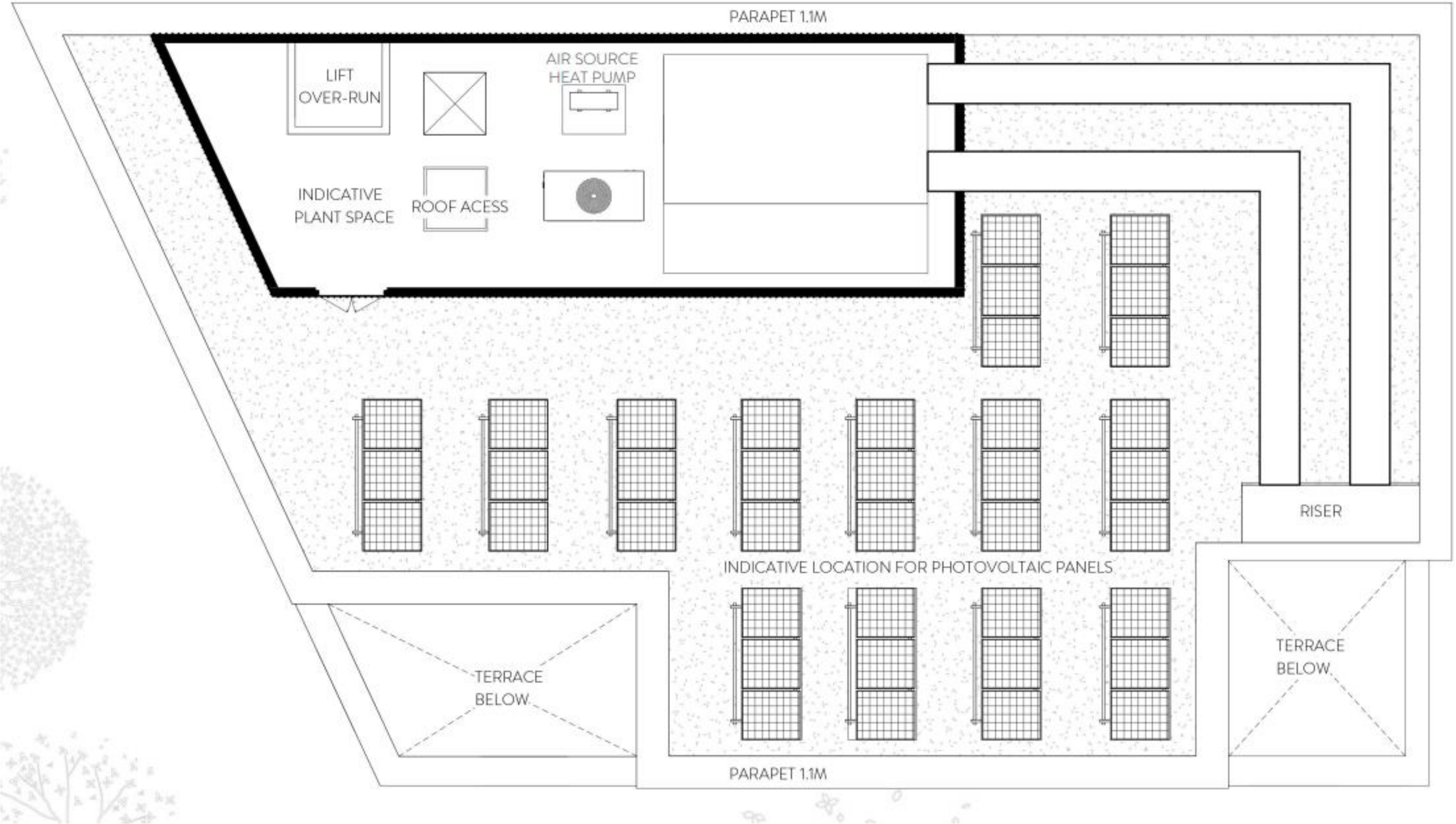


Figure 25 - Community Centre Roof Layout

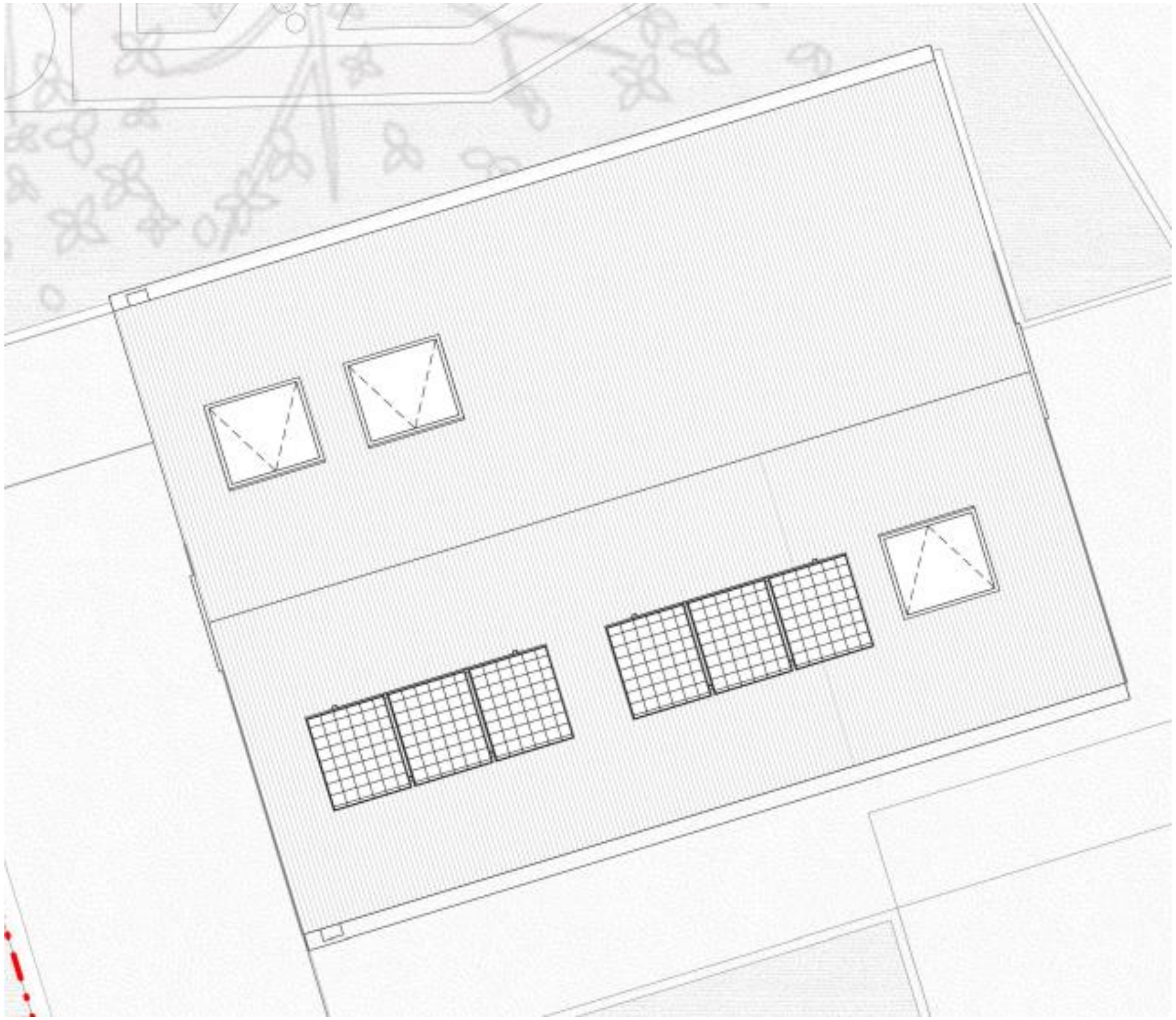
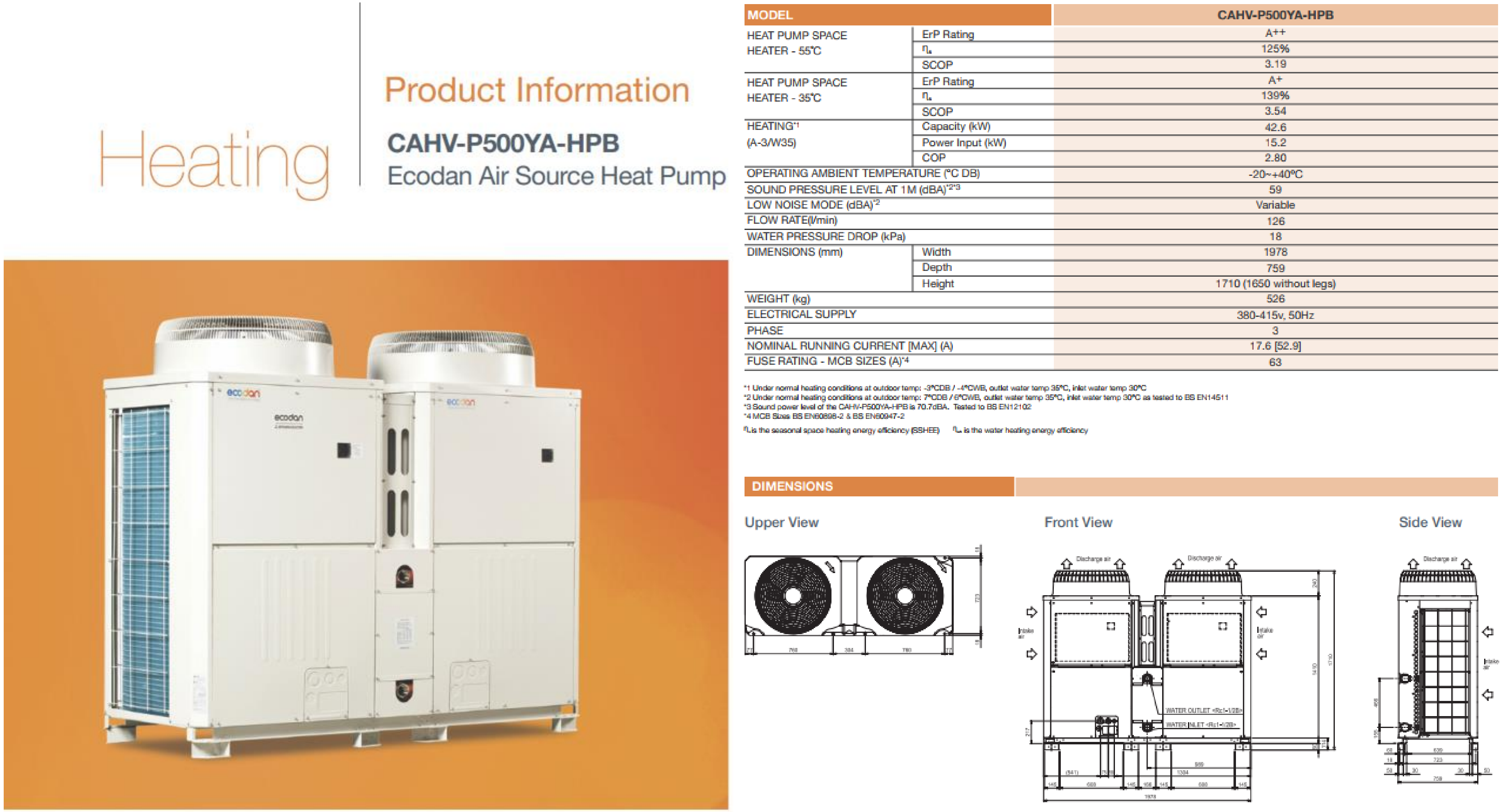


Figure 26 - Maker Labs Roof Layout

APPENDIX 7: PROPOSED ASHP DATASHEETS



Heating

Product Information

CAHV-P500YA-HPB

Ecodan Air Source Heat Pump

MODEL		CAHV-P500YA-HPB
HEAT PUMP SPACE HEATER - 55℃	ErP Rating	A++
	η_s	125%
	SCOP	3.19
HEAT PUMP SPACE HEATER - 35℃	ErP Rating	A+
	η_s	139%
	SCOP	3.54
HEATING[*1] (A-3/W35)	Capacity (kW)	42.6
	Power Input (kW)	15.2
	COP	2.80
OPERATING AMBIENT TEMPERATURE (°C DB)		-20~+40°C
SOUND PRESSURE LEVEL AT 1M (dBA)[*2*3]		59
LOW NOISE MODE (dBA)[*2]		Variable
FLOW RATE(l/min)		126
WATER PRESSURE DROP (kPa)		18
DIMENSIONS (mm)	Width	1978
	Depth	759
	Height	1710 (1650 without legs)
WEIGHT (kg)		526
ELECTRICAL SUPPLY		380-415v, 50Hz
PHASE		3
NOMINAL RUNNING CURRENT [MAX] (A)		17.6 [52.9]
FUSE RATING - MCB SIZES (A)[*4]		63

[*1] Under normal heating conditions at outdoor temp: -3°CDB / -4°CWB, outlet water temp 35°C, inlet water temp 30°C
[*2] Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 35°C, inlet water temp 30°C as tested to BS EN14511
[*3] Sound power level of the CAHV-P500YA-HPB is 70.7dBA. Tested to BS EN12102
[*4] MCB Sizes BS EN60898-2 & BS EN60947-2

η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

DIMENSIONS

Upper View

Front View

Side View

TECHNICAL SELECTION

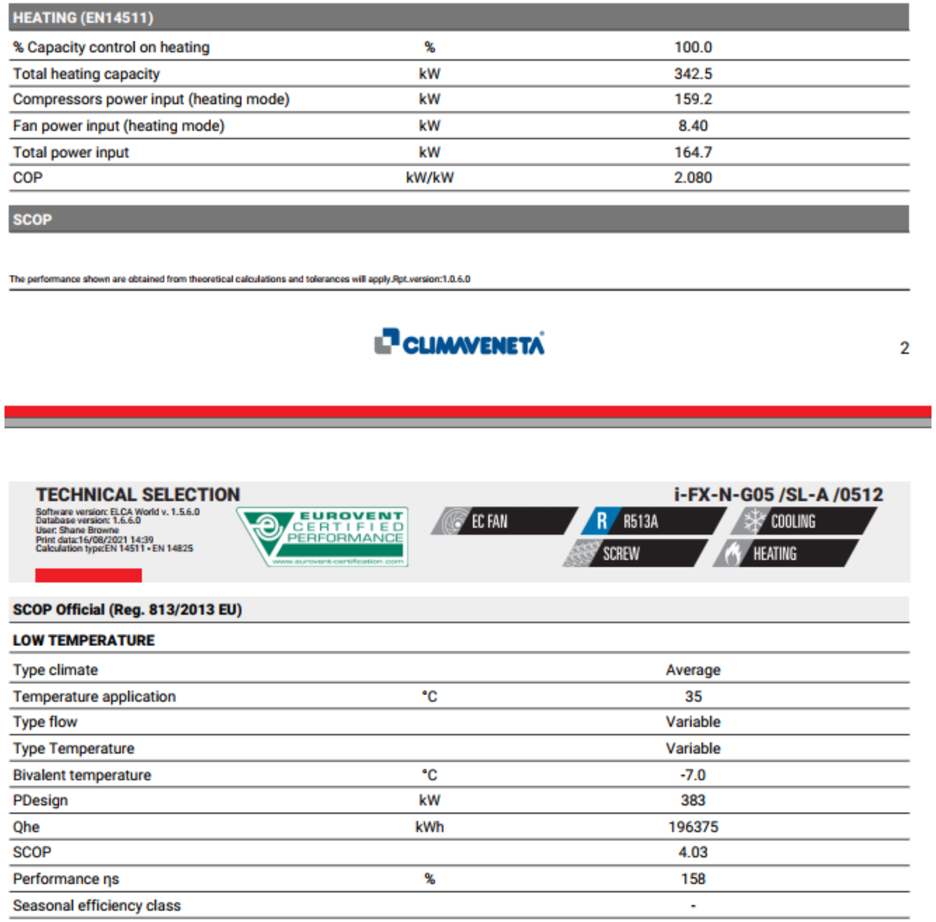
i-FX-N-G05 /SL-A /0512

Reversible unit, air source, VSD screw compressors and EC fans, for outdoor installation.

R513A

SCREW

Code		i-FX-N-G05 /SL-A /0512
Version		SL-A
Size		0512
Power supply	V/ph/Hz	400/3/50



HEATING (EN14511)		
% Capacity control on heating	%	100.0
Total heating capacity	kW	342.5
Compressors power input (heating mode)	kW	159.2
Fan power input (heating mode)	kW	8.40
Total power input	kW	164.7
COP	kW/kW	2.080

SCOP

The performance shown are obtained from theoretical calculations and tolerances will apply.Rpt.version:1.0.6.0

CLIMAVENETA 2

TECHNICAL SELECTION

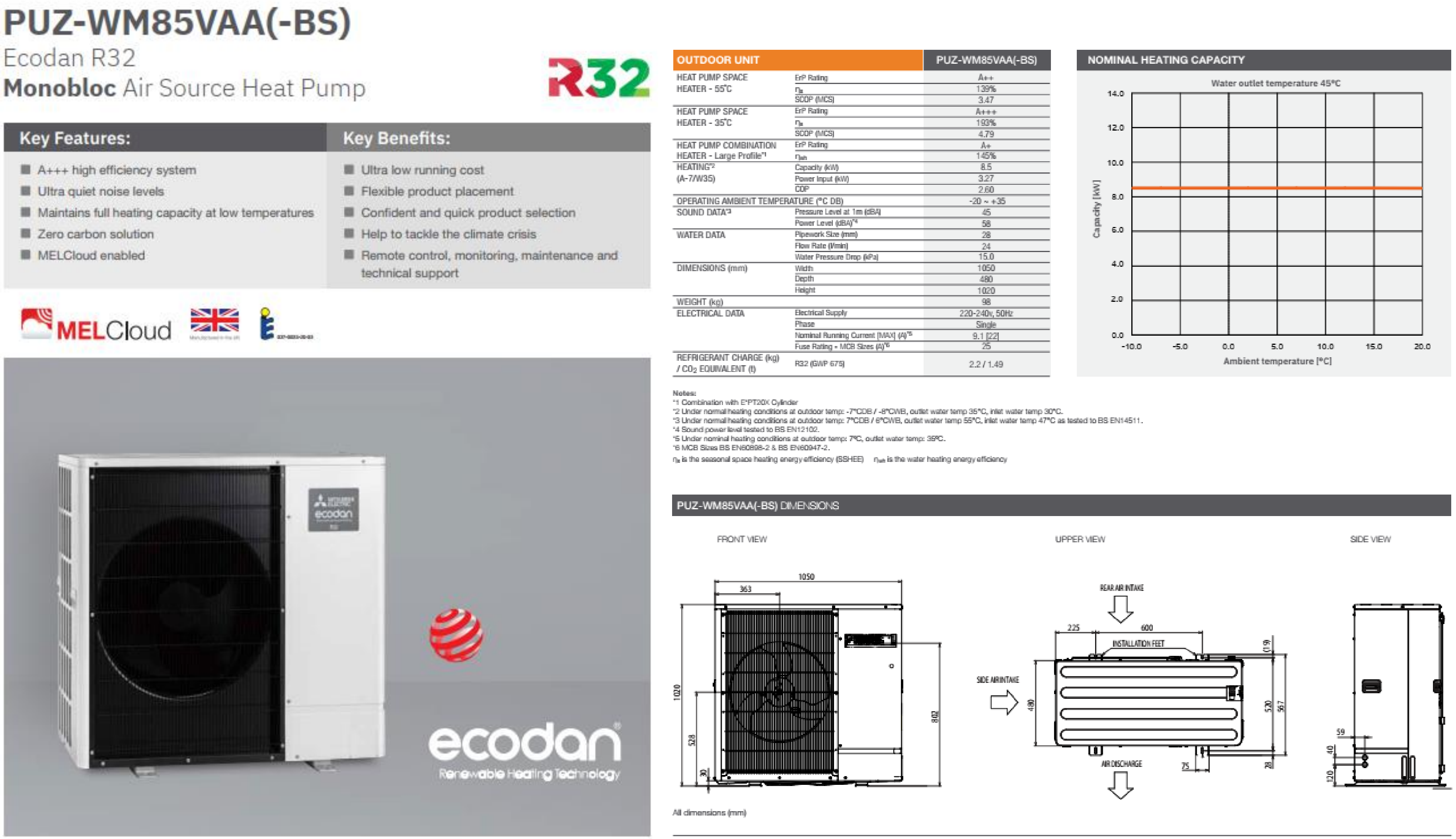
Software version: ELCA World v. 1.5.6.0
Database version: 1.6.6.0
User: Shane Browne
Print data:16/08/2021 14:39
Calculation type:EN 14511 • EN 14825

EUROVENT CERTIFIED PERFORMANCE www.eurovent-certification.com

EC FAN R513A COOLING SCREW HEATING

i-FX-N-G05 /SL-A /0512

SCOP Official (Reg. 813/2013 EU)		
LOW TEMPERATURE		
Type climate		Average
Temperature application	°C	35
Type flow		Variable
Type Temperature		Variable
Bivalent temperature	°C	-7.0
PDesign	kW	383
Qhe	kWh	196375
SCOP		4.03
Performance ηs	%	158
Seasonal efficiency class		-



PUZ-WM85VAA(-BS)

Ecodan R32

Monobloc Air Source Heat Pump

Key Features:	Key Benefits:
A+++ high efficiency system	Ultra low running cost
Ultra quiet noise levels	Flexible product placement
Maintains full heating capacity at low temperatures	Confident and quick product selection
Zero carbon solution	Help to tackle the climate crisis
MELCloud enabled	Remote control, monitoring, maintenance and technical support

OUTDOOR UNIT		PUZ-WM85VAA(-BS)
HEAT PUMP SPACE HEATER - 55˚C	ErP Rating	A++
	η_s	139%
	SCOP (MCS)	3.47
HEAT PUMP SPACE HEATER - 35˚C	ErP Rating	A+++
	η_s	193%
	SCOP (MCS)	4.79
HEAT PUMP COMBINATION HEATER - Large Profile*1	ErP Rating	A+
	η_{wh}	145%
HEATING*2 (A-7/W35)	Capacity (kW)	8.5
	Power Input (kW)	3.27
	COP	2.60
OPERATING AMBIENT TEMPERATURE (°C DB)		-20 ~ +35
SOUND DATA*3	Pressure Level at 1m (dBA)	45
	Power Level (dBA)*4	58
WATER DATA	Pipework Size (mm)	28
	Flow Rate (l/min)	24
	Water Pressure Drop (kPa)	15.0
DIMENSIONS (mm)	Width	1050
	Depth	480
	Height	1020
WEIGHT (kg)		98
ELECTRICAL DATA	Electrical Supply	220-240v, 50Hz
	Phase	Single
	Nominal Running Current [MAX] (A)*5	9.1 [22]
	Fuse Rating - MCB Sizes (A)*6	25
REFRIGERANT CHARGE (kg) / CO_2 EQUIVALENT (t)	R32 (GWP 675)	2.2 / 1.49

Notes:
*1 Combination with E*PT20X Cylinder
*2 Under normal heating conditions at outdoor temp: -7°CDB / -8°CWB, outlet water temp 35°C, inlet water temp 30°C.
*3 Under normal heating conditions at outdoor temp: 7°CDB / 6°CWB, outlet water temp 55°C, inlet water temp 47°C as tested to BS EN14511.
*4 Sound power level tested to BS EN12102.
*5 Under nominal heating conditions at outdoor temp: 7°C, outlet water temp: 35°C.
*6 MCB Sizes BS EN60898-2 & BS EN60947-2.
η_s is the seasonal space heating energy efficiency (SSHEE) η_{wh} is the water heating energy efficiency

NOMINAL HEATING CAPACITY

PUZ-WM85VAA(-BS) DIMENSIONS

All dimensions (mm)

APPENDIX 8: HEAT NETWORK DRAWINGS

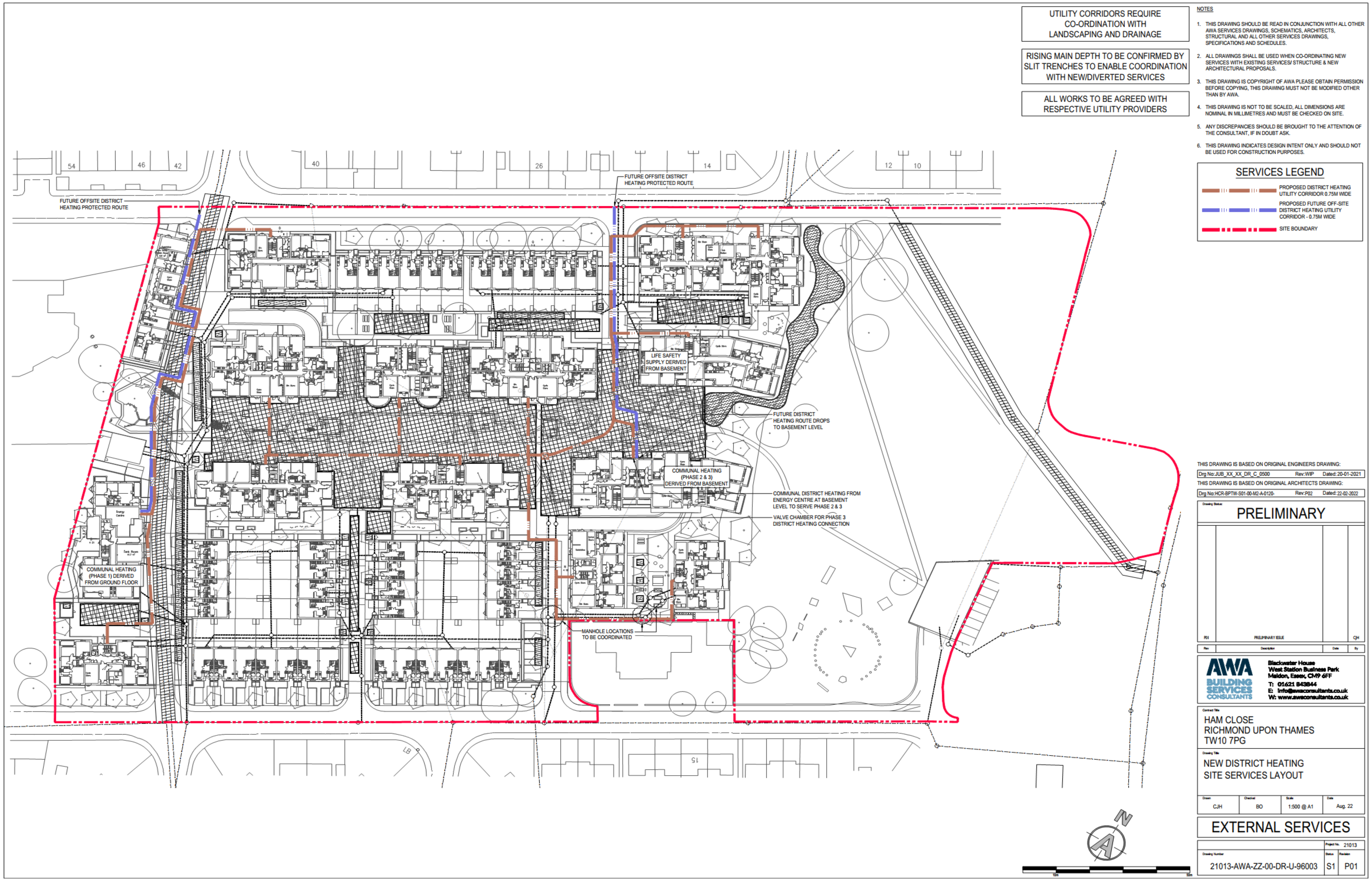
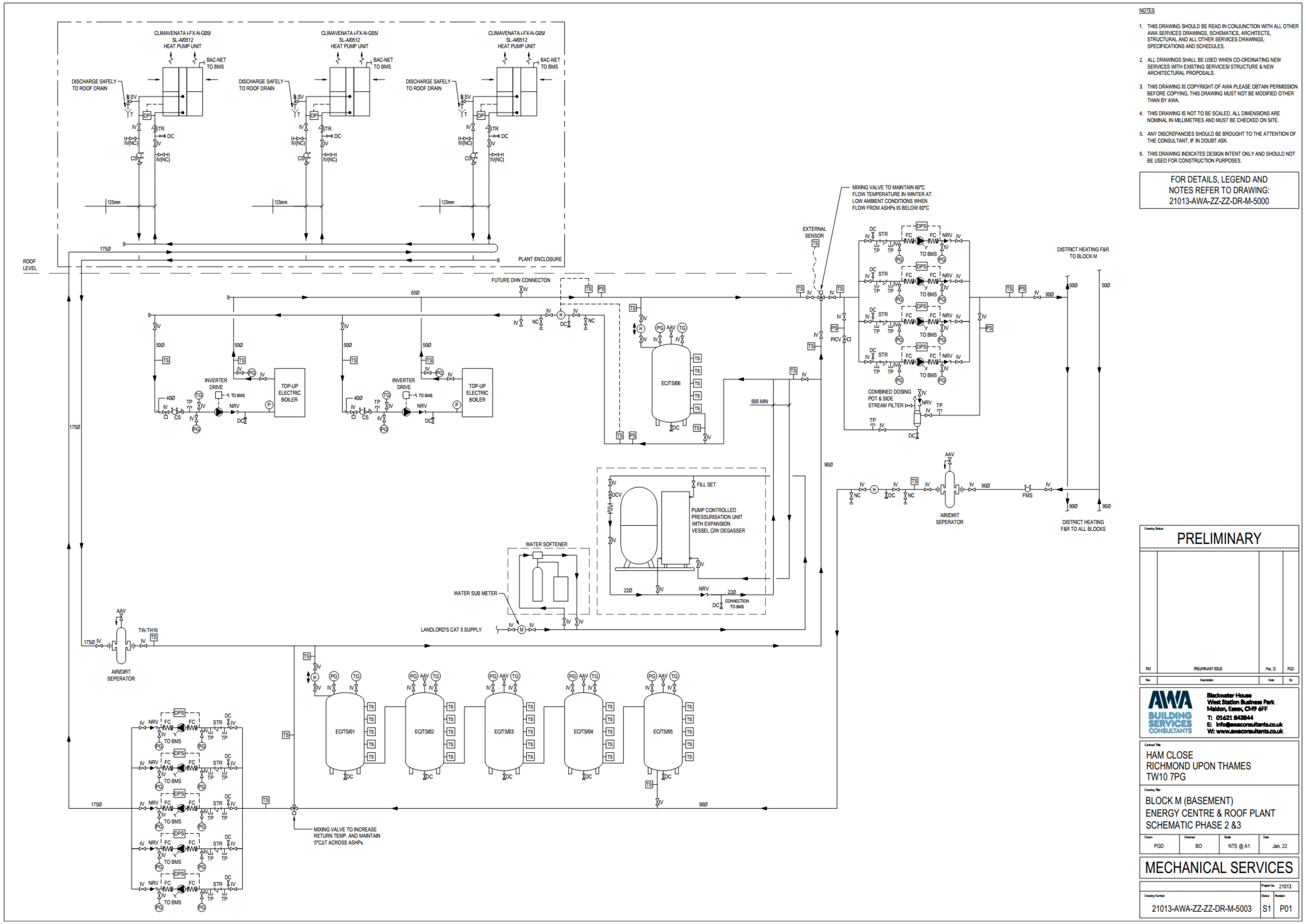


Figure 27 - Site plan showing heat network distribution routes (AWA drawing 21013-AWA-ZZ-00-DR-U-96003)



NOTES

1. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER AWA SERVICES DRAWINGS, SCHEMATICS, ARCHITECTS, STRUCTURAL AND ALL OTHER SERVICES DRAWINGS, SPECIFICATIONS AND SCHEDULES.
2. ALL DRAWINGS SHALL BE USED WHEN CO-ORDINATING NEW SERVICES WITH EXISTING SERVICES/ STRUCTURE & NEW ARCHITECTURAL PROPOSALS.
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21013-AWA-ZZ-ZZ-DR-M-5000

Drawing Status: PRELIMINARY

Rev	Description	Date	By
P01	PRELIMINARY ISSUE	Mar. 22	PGD

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Drawing Title:
BLOCK M (BASEMENT)
ENERGY CENTRE & ROOF PLANT
SCHEMATIC PHASE 2 &3

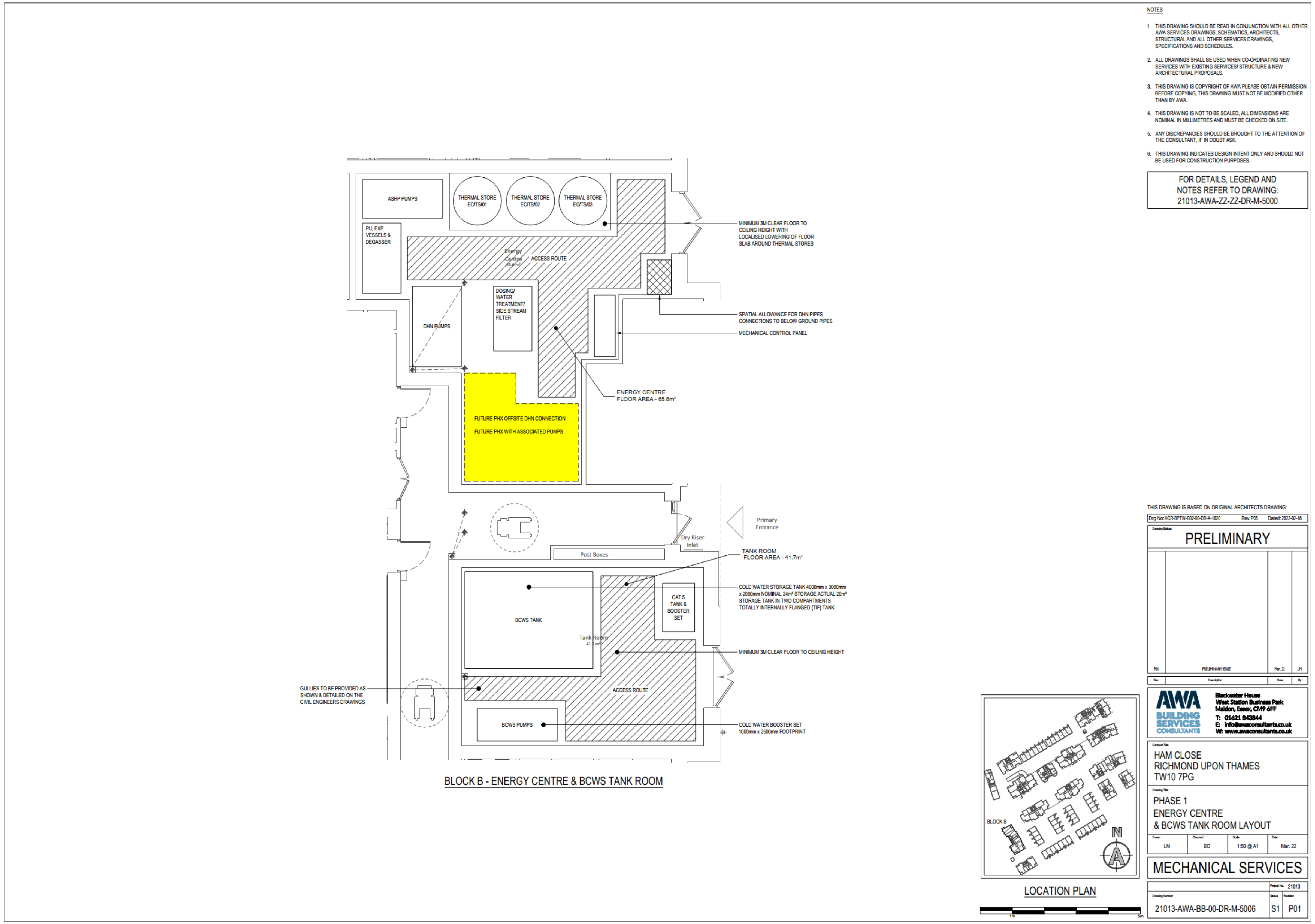
Drawn	Checked	Scale	Date
PGD	BO	NTS @ A1	Jan. 22

MECHANICAL SERVICES

Project No. 21013

Drawing Number	Status	Revision
21013-AWA-ZZ-ZZ-DR-M-5003	S1	P01

Figure 28 - Energy centre schematic, showing future DHN connection point (AWA drawing 21013-AWA-ZZ-ZZ-DR-M-5003)



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Drg No: HCR-BPTW-B02-00-DR-A-1020 Rev:P05 Dated: 2022-02-18

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Drawing Title:
PHASE 1
ENERGY CENTRE
& BCWS TANK ROOM LAYOUT

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LM	BO	1:50 @ A1	Mar. 22

MECHANICAL SERVICES

Project No. 21013
Drawing Number: 21013-AWA-BB-00-DR-M-5006
Status: S1
Revision: P01

Figure 29 - Phase 1 Energy Centre, proposed plant room layout indicating future DHN connection space provision (AWA drawing 21013-AWA-BB-00-DR-M-5006)

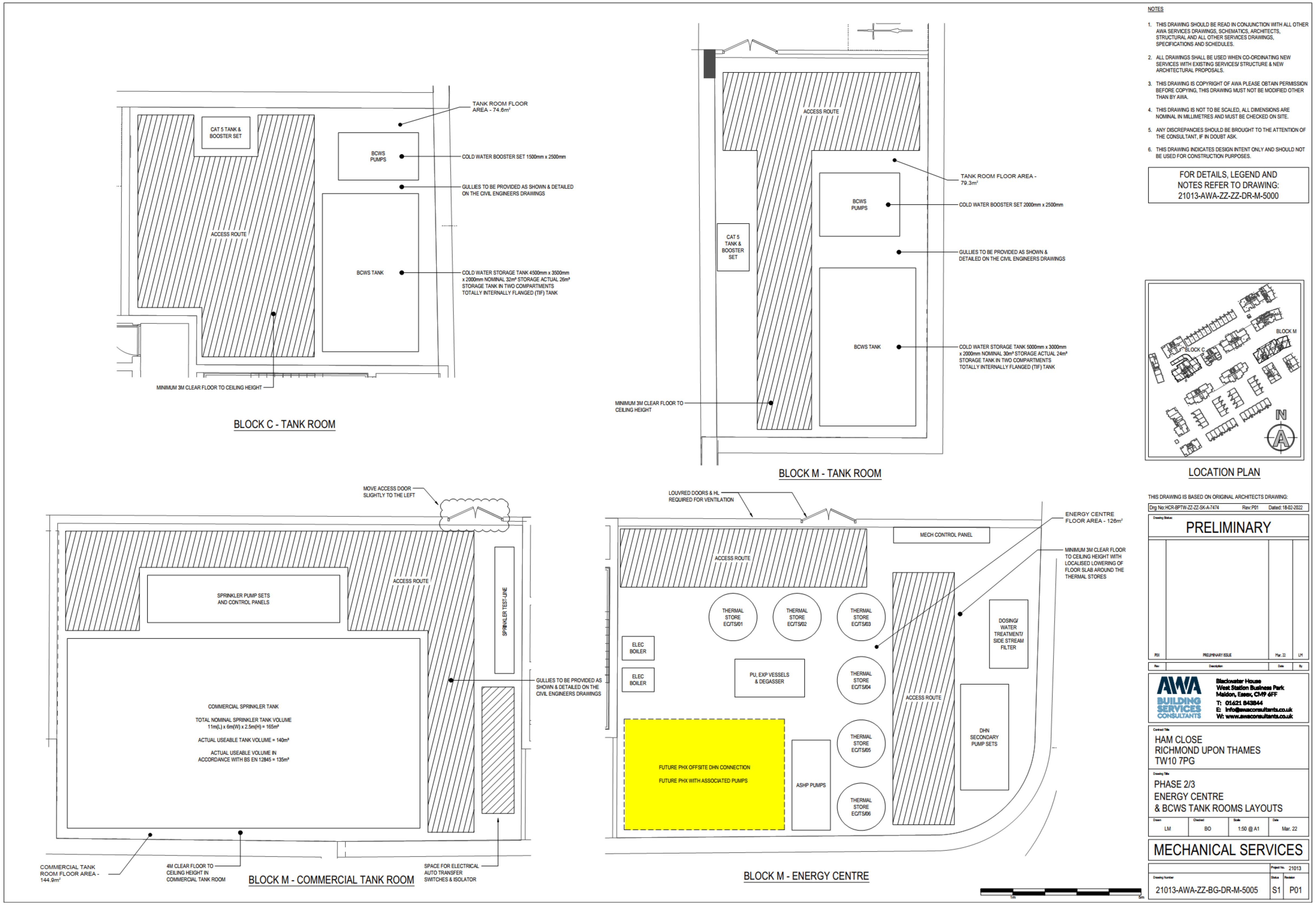

Figure 30 - Phase 2/3 Energy Centre, proposed plant room layout indicating future DHN connection space provision (AWA drawing 21013-AWA-BB-00-DR-M-5006)