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London Borough of Hounslow

Heat Decarbonisation Plan
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1. Purpose

The rising impact and cost of carbon emissions mean that public sector organisations are under increasing pressure to reduce their emissions. In addition, with energy prices predicted to continue to rise, there is an increasing need for all organisations to achieve savings. As such, reducing carbon emissions leads to direct financial, risk management and reputational benefit to public sector, third sector and commercial organisations alike.

The London Borough of Hounslow recognises that the environment has a huge impact on the quality of the lives of local residents and if the most is made of existing and emerging technologies, the challenges of climate change can be reframed to build a cleaner, greener portfolio which reaps the economic rewards of a clean growth revolution, while eliminating health and social inequalities and their associated costs.

The London Borough of Hounslow intends to replace fossil fuel reliant systems with low carbon alternatives (e.g. Heat Pumps). To contribute towards their objective of carbon neutrality by 2030.

XX XXX have been commissioned by the London Borough of Hounslow to produce this Heat Decarbonisation Plan, which has been funded via BEIS's Low Carbon Skills Fund. There are a number of schools within the Borough that have not benefitted from either previous rounds of energy conservation work delivered through the RE:FIT framework and/or through decarbonisation work delivered through Phase 1 of the Public Sector Decarbonisation Scheme (PSDS). This plan has been focused on those schools and outlines what has already done, what it is currently doing, what options it has and applicability to Phase 3 of the PSDS.

2. Introduction

The London Borough of Hounslow has already delivered a significant amount of energy and carbon reduction measures across its schools, through Salix Energy Efficiency Loans, Heathrow Airports Consequential Improvement Fund and Phase 1 of the Public Sector Decarbonisation Scheme.

This plan focuses on opportunities for heat decarbonisation across 10 schools, that have not benefitted from previous heat decarbonisation measures. The plan also reviews energy efficiency measure opportunities to reduce demand and where possible offset the additional cost of moving to an electricity consuming low carbon heat source such as Air Source Heat Pumps.

Heat Decarbonisation Plan

3. Buildings

School Name	Postcode	UPRN	DEC	Gas Consumption	Elec Consumption	Gross Internal Area (m^2)
Rosary RC School	TW5 0RL	100023405204	D	194,540	48,280	1,420
Brentford School for Girls	TW8 0PG	100023407384	D	820,415	221,788	6,237
Strand on the Green	W4 3NX	100023491477	C	349,156	100,086	3,365
Gumley School	TW7 6XF	100023406817	C	274,040	362,440	4,420
Lampton School	TW3 4EP	100023403901	D	437,283	743,949	5,679
Victoria Junior School	TW13 4AQ	100023398789	E	220,220	86,240	1,540
St Lawrence	TW13 4FF		E	299,641	91,639	1,964
Feltham Hill Infant & Nursery	TW13 4LZ	100023398791	E	270,512	72,239	1,537
Isleworth Town Primary	TW7 6AB	100023406820	E	210,490	312,728	3,007
Isleworth & Syon	TW7 5LJ	100023663043	C	1,707,885	2,479,596	12,651

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3.1 Existing Fossil Fuel Heating System

Each school has an existing fossil fuel heating system which can be illustrated in the below Figure 3.1.

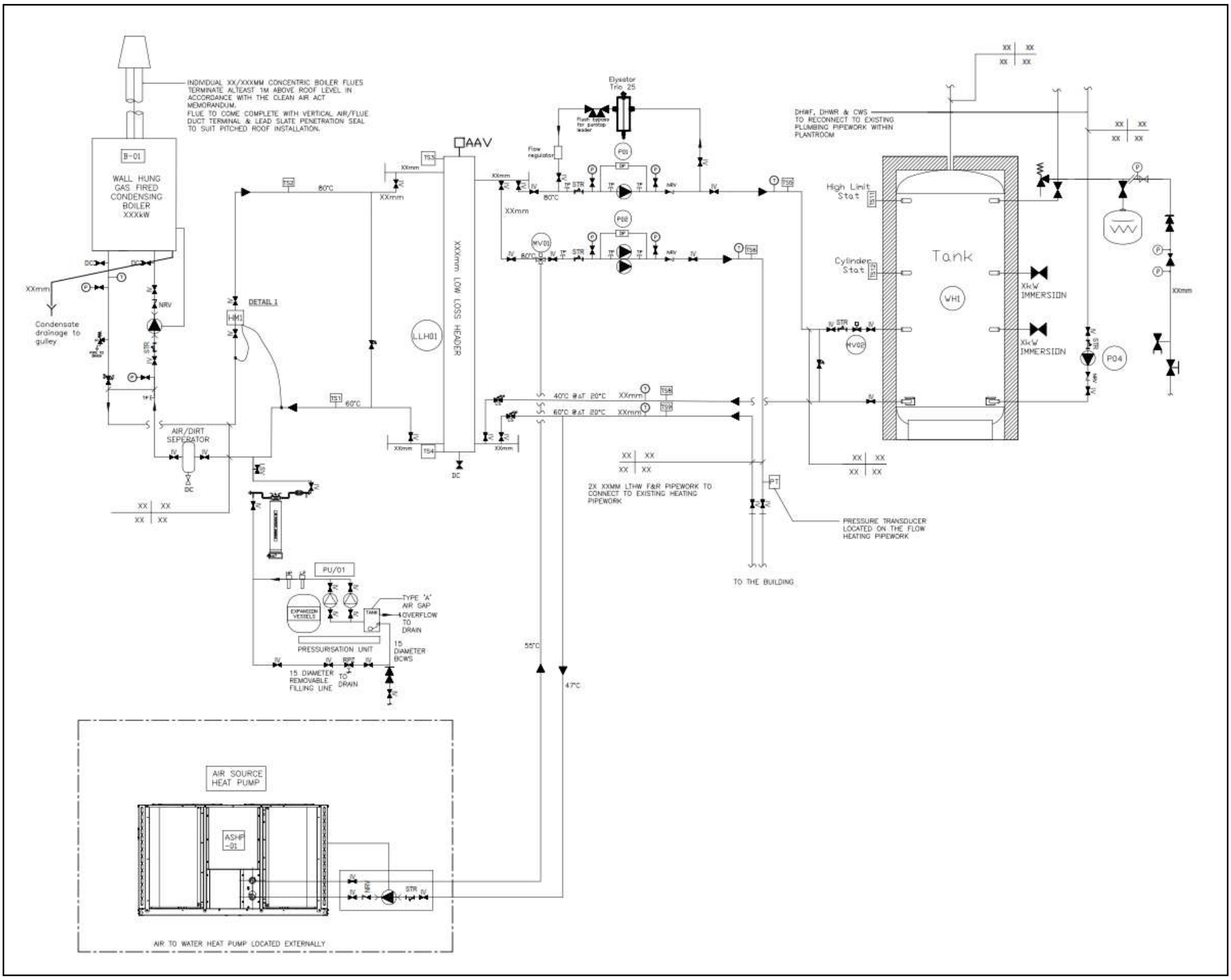

Figure 3.1 Existing Heating System Schematic

Heat Decarbonisation Plan

The table below provides details of the existing fossil fuel systems at each school that are at or nearing end of life.

School Name	Make	Model	Age of system* (years)	Output load per unit* (kW)	Number of duty units*	Total output load (kW)
Rosary RC School	Hamworthy	UR300	25	68	1	68
Brentford School for Girls	Hamworthy	Purewell	25	70	1	70
	Potterton	NXR2	15	250	2	500
	Remeha	460	15	250	1	250
	Strebel		15	200	2	400
Strand on the Green	Strebel	KFG 2233 BGK	21	300	2	600
	Buderus	G324L Lowmax	24	73	2	146
Gumley School	Potterton	Commercial NXR4	14	250	2	500
Lampton School	Remeha		20	600	2	1200
Victoria Junior School	Potterton	WH90	15	85	4	340
St Lawrence	Andrews	25/49	26	11	1	11
Feltham Hill Infant & Nursery	Hamworthy	Purewell	20	100	1	100
Isleworth Town Primary	Stebel		16	220	1	220
Isleworth & Syon	Beaumont	360	23	174	1	174

4. Resources

The London Borough of Hounslow Energy team are responsible for managing the energy consumption across the estate and will be overseeing the delivery of the Heat Decarbonisation Plan.

The Hounslow Energy Team led by Charles Pipe have many years of overseeing and managing energy efficiency and decarbonisation schemes. Alongside this there is an existing RE:FIT framework contract in place for both schools and corporate buildings with XX XXX. This RE:FIT framework will be utilised for the identification, development, and delivery of the HDP.

Additional finance will be required to deliver the HDP and it is anticipated that further rounds of the Public Sector Decarbonisation Scheme will be applied for.

5. Previous energy efficiency projects and existing low carbon heating technology

None of the schools contained in this plan have undertaken previous energy efficiency projects or have existing low carbon heating technology the Rosary RC school.

Rosary RC School

The following ECM's where delivered via a Salix Energy Efficiency Loan through the RE:FIT framework;

- Fridge Compressor Control 3,446kW/pa Elec Saving
- LED Lighting Upgrade 56,080kWh/pa Elec Saving

On the Primary School the following ECM's have been delivered vi Phase 1 of the PSDS;

- 45kW Air Source Heat Pump 122,718kWh/pa Gas Saving (21,412kWh Elec Consumption)
- 49.78kWp Solar PV Array 46,780kWh/pa Elec Generation
- 10kW Battery Storage

The works outlined above have been factored into the calculations for the works proposed in this plan for Rosary which are on the Junior School.

6. Heating networks and opportunities on site

There are currently no local heat resources available that could facilitate the transition to low carbon heat. None of the schools have a sufficiently high heat demand can provide a baseload for a district heating network which will have benefits for the wider community.

There are no known existing or planned heat network developments located close to the sites that these schools buildings could connect to.

7. Electricity loading capacity to support a switch to electric heating solutions

In the timescales of compiling this plan there has been no engagement with the local District Network Operator (SSE). However the proposal within this includes for a 15kWp Solar PV array for each site to offset much if not all the additional electricity consumption from the proposed Air Source Heat Pumps.

During the pre-construction phase of the proposed works an application would be submitted to SSE for connection of proposed ECMs.

8. Supporting information

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Brentford School for Girls

	Value	Unit
Building Thermal Capacity ΣUA	16,758	W/K
Volume of Space to be Heated by Heat Pump	*3,685.00*	m^3
Air Changes per Hour	*2.00*	ACH
Ventilation Loss	2,457	W/K
Heat Loss Coefficient	19,215	W/K
U'	19	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**422.73**	kW

Rosary RC School

	Value	Unit
Building Thermal Capacity ΣUA	3,984	W/K
Volume of Space to be Heated by Heat Pump	*2,328.00*	m^3
Air Changes per Hour	*1.70*	ACH
Ventilation Loss	1,319	W/K
Heat Loss Coefficient	5,304	W/K
U'	5	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*0.00*	°C
Peak Building Heat Loss	**100.77**	kW

Strand on the Green School

	Value	Unit
Building Thermal Capacity ΣUA	7,217	W/K
Volume of Space to be Heated by Heat Pump	*1,635.00*	m^3
Air Changes per Hour	*1.70*	ACH
Ventilation Loss	927	W/K
Heat Loss Coefficient	8,143	W/K
U'	8	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**179.15**	kW

Gumley School

	Value	Unit
Building Thermal Capacity ΣUA	5,821	W/K
Volume of Space to be Heated by Heat Pump	*1,211.00*	m^3
Air Changes per Hour	*1.50*	ACH
Ventilation Loss	606	W/K
Heat Loss Coefficient	6,426	W/K
U'	6	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**141.37**	kW

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Lampton School

	Value	Unit
Building Thermal Capacity ΣUA	8,126	W/K
Volume of Space to be Heated by Heat Pump	*3,505.00*	m^3
Air Changes per Hour	*1.80*	ACH
Ventilation Loss	2,103	W/K
Heat Loss Coefficient	10,229	W/K
U'	10	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**225.03**	kW

Victoria Junior School

	Value	Unit
Building Thermal Capacity ΣUA	4,317	W/K
Volume of Space to be Heated by Heat Pump	*2,928.00*	m^3
Air Changes per Hour	*1.70*	ACH
Ventilation Loss	1,659	W/K
Heat Loss Coefficient	5,976	W/K
U'	6	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*0.00*	°C
Peak Building Heat Loss	**113.55**	kW

St Lawrence School

	Value	Unit
Building Thermal Capacity ΣUA	5,598	W/K
Volume of Space to be Heated by Heat Pump	*2,168.00*	m^3
Air Changes per Hour	*2.00*	ACH
Ventilation Loss	1,445	W/K
Heat Loss Coefficient	7,043	W/K
U'	7	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**154.94**	kW

Feltham Hill Infant & Nursery School

	Value	Unit
Building Thermal Capacity ΣUA	4,432	W/K
Volume of Space to be Heated by Heat Pump	*3,381.00*	m^3
Air Changes per Hour	*1.70*	ACH
Ventilation Loss	1,916	W/K
Heat Loss Coefficient	6,348	W/K
U'	6	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**139.65**	kW

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Isleworth Town Primary

	Value	Unit
Building Thermal Capacity ΣUA	4,601	W/K
Volume of Space to be Heated by Heat Pump	*2,102.00*	m^3
Air Changes per Hour	*1.50*	ACH
Ventilation Loss	1,051	W/K
Heat Loss Coefficient	5,652	W/K
U'	6	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*0.00*	°C
Peak Building Heat Loss	**107.39**	kW

Isleworth & Syon School

	Value	Unit
Building Thermal Capacity ΣUA	34,795	W/K
Volume of Space to be Heated by Heat Pump	*7,721.00*	m^3
Air Changes per Hour	*2.00*	ACH
Ventilation Loss	5,147	W/K
Heat Loss Coefficient	39,942	W/K
U'	40	kW/K
Winter Internal Setpoint Temperature	*19.00*	°C
Winter Outdoor Design Temperature	*-3.00*	°C
Peak Building Heat Loss	**878.73**	kW

9. **Plans for the sites**

Proposal Summary

No.	School	ECM	Saving (Gas)	Saving Elec	Cost
1	Rosary RC School	45kW Air Source Heat Pump	80,150	- 20,038	£138,350
		15kWp Solar PV		14,750	£19,500
2	Brentford School for Girls	180kW Air Source Heat Pump	350,656	- 87,664	£443,450
		15kWp Solar PV		14,750	£19,500
3	Strand on the Green	90kW Air Source Heat Pump	178,837	- 44,709	£265,450
		15kWp Solar PV		14,750	£19,500
		LED Lighting Upgrade		81,857	£72,480
4	Gumley School	90kW Air Source Heat Pump	153,776	- 28,945	£164,530
		17kW Solar Thermal Array	45,246		£64,680
		15kWp Solar PV		14,750	£19,500
5	Lampton School	90kW Air Source Heat Pump	286,892	- 57,345	£267,343
		17kW Solar Thermal Array	45,246		£64,680
		15kWp Solar PV		14,750	£19,500
6	Victoria Junior School	45kW Air Source Heat Pump	129,161	- 25,432	£150,581
		17kW Solar Thermal Array	45,246		£64,680
		15kWp Solar PV		14,750	£19,500
7	St Lawrence	17kW Solar Thermal Array	45,246	-	£64,680
		15kWp Solar PV		14,750	£19,500
8	Feltham Hill Infant & Nursery	57kW Air Source Heat Pump	120,225	- 30,056	£120,695
		15kWp Solar PV		14,750	£19,500
9	Isleworth Town Primary	135kW Air Source Heat Pump	133,011	- 33,253	£276,475
		15kWp Solar PV		14,750	£19,500
10	Isleworth & Syon	57kW Air Source Heat Pump	120,225	- 30,056	£123,945
		17kW Solar Thermal Array	45,246		£64,680
		15kWp Solar PV		14,750	£19,500
	All Schools	Pipe Insulation	59,745		£45,000
	All Schools	Draught Proofing	147,535		£32,865
		TOTAL:-	**1,986,443**	**- 128,141**	**£2,619,564**

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Technical Proposals

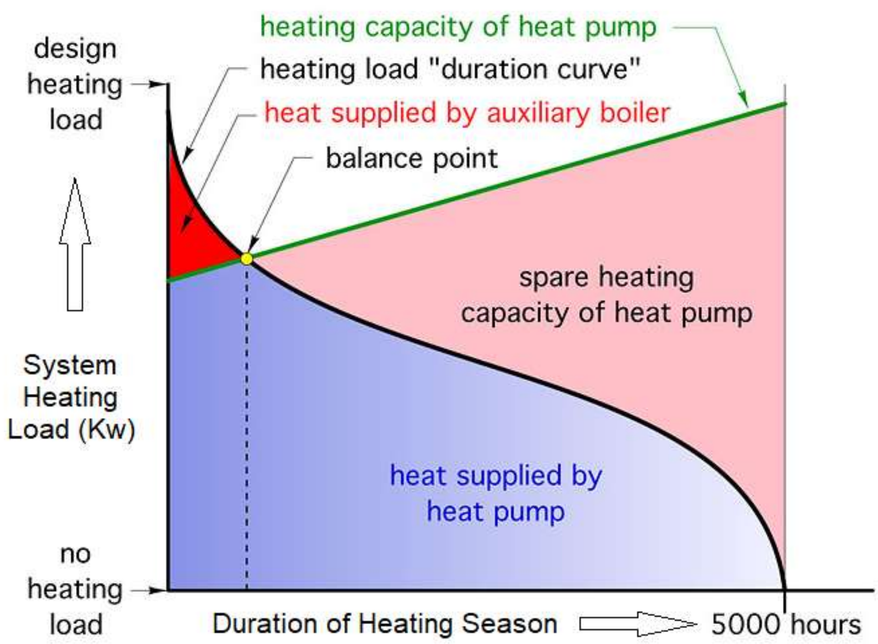
Where heating systems are migrating away from Fossil Fuels, local authorities/schools are often concerned that the high capital and running costs of schemes based around an ASHP designed to meet "Peak" heat loss capacity replacement of the older fossil fuel heat source, in that it will not be financial viable.

Our approach for mitigating those concerns is to install a "Hybrid" or "Bi-Valent" system solution, as a stepping stone to full net zero, and ensure that the ASHP "Balance Point" is at a high enough SCOP (Seasonal Co-efficient of performance) to deliver an output higher than manufacturer's SCOP in a total replacement scenario. To achieve this, the ASHP can be sized at less than the demand peak.

The Hybrid system operates by replacing a proportion of the peak load with ASHP capacity and amending the system control strategy to maximise the opportunity for the ASHP to operate at its peak Coefficients of performance for the maximum amount of the rest of the heating season.

In this way, the required boiler capacity for peak loads (outlined in red within the diagram below) is greatly reduced, and the effective amount of seasonal load that the ASHP can meet (Outlined in pink) is greatly increased, whilst reducing capital and running costs.

"Hybrid" or "Bi-Valent" Air Source Heat Pump Control Strategies



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The systems include for weather compensating the flow temperature of the variable temperature LTHW heating systems. When ambient temperatures are above the heat pump balance point (see diagram) the heat pump COP is maximised, allowing for a greater SCOP overall. Under these circumstances, the ASHP “leads” with the boilers as secondary heat sources. When the ambient temperature is below the heat pump balance point, the boilers lead and the ASHP takes a reducing proportion of the load, retaining the SCOP gains that the previous strategy delivered earlier in the season.

The system operates by use of an external temperature sensor (TS). This is set at to an external balance point temperature above which the heating load is satisfied by the heat pump alone. If the external ambient temperature drops below this set point then the heat pump will reduce its load, and the remaining supplementary boiler plant will make up the shortfall in capacity.

The heat pump will deliver most of the heating needed during a large part of the year, as they modulate in combination with the weather compensation control functionality. This allows the heat pumps to only produce the heat required and to vary the temperature of the water in the radiators themselves if required.

The heat pumps will be used to pre-heat the building in the morning prior to occupation.

The approach taken combines both Air Source Heat Pumps with Solar Thermal arrays for each site. In combining these technologies, the effects of increased working temperatures of the glycol medium in the Solar Thermal arrays are enhanced by better methods of transferring that higher grade heat into heating circuits. Balancing these factors creates an optimal relationship between ASHP and Solar Thermal system sizing. The addition of a Solar Thermal contribution to energy that previously only came from the water heated by an ASHP, effectively enhances the seasonal efficacy of the unit, allowing it to operate at higher Coefficients of Performance when the outside air temperature would previously have reduced its COP well below optimal levels. In this way, the ST/ASHP combined system is able to offset a greatly increased amount of gas that would otherwise have had to be burnt in the boilers.

The approach to energy efficiency measures has been to eliminate identified areas of energy wastage, where it is feasible to do so. In particular draught proofing and pipe/valve insulation are simple measures that will improve heat loss within the building enabling efficiency from the ASHP. Whilst Solar PV and LED Lighting will assist on meeting the additional electricity consumption from the ASHP, ensuring there is no increase in annual energy bills for each school, which is from experience a significant barrier to obtaining buy in.

10. Key Risks

The key risks or issues surrounding the feasibility or deliverability of this plan are highlighted below.

Description of Risk	Level of Risk	Type of Risk	How will the risk be managed and/or mitigated?
Equipment Price Increases	Moderate	Cost	Contingency to be allowed in project costs
Equipment Delivery Timescales	Moderate	Schedule	Contingency to be allowed in delivery programme
Covid-19	Moderate	Schedule	Contingency to be allowed in delivery programme
Asbestos	Moderate	Cost/Schedule	Allowance made within costs for undertaking Targeted Refurbishment Surveys on each site
Water Quality	Moderate	Cost/Schedule	Allowance made to test a sample of the existing heating system water quality
Site Electrical Capacity	Moderate	Cost/Schedule	Proposal includes for a Solar PV array for each site to offset much if not all the additional electricity consumption from the proposed ASHPs.