C151598: Cleveland Pools
Heating and Hot Water Options

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INTRODUCTION

The purpose of this report is to present the preferred heating and hot water options for the proposed Cleveland Pools Restoration project in Bath.

HEATING AND HOT WATER SUMMARY

The following options, outlined in further detail within this report, are the preferred solutions for the development:

Option		Blocks
1	Water Source Heat Pump (WSHP)	Site wide
2	Air Source Heat Pump (ASHP)	Site wide
3	Hybrid system – WSHP or ASHP combined with gas fired boilers	Site wide

HEATING AND HOT WATER OPTIONS

There are a number of options available for providing heating and hot water to the development. The following three alternative schemes were analysed for this report:

1. Water Source Heat Pumps providing heating and hot Water to pool areas and heated building spaces
2. Air source Heat Pumps providing heating and hot hater to pool areas and heated building spaces
3. A Hybrid system comprising an WSHP or ASHP combined with gas fired boilers

The following section outlines the various options with Table 1 at the end providing a summary of the advantages and disadvantages. Schematic diagrams are provided for each option. A conclusion is then discussed with Hydrock's preferred option.

Option 1 – Water Source Heat Pumps (WSHP)

WSHP's utilise energy in the water to generate useful heat. Heat from the water is either pumped through a heat exchanger (open loop system) or alternatively it absorbed into refrigerant which is pumped through a heat exchanger. Low grade heat is then converted to high grade heat by the compressor. The heat is then be transferred to water which can be used in a conventional wet heating system. WSHPs can also be used in reverse to generate cooling. WSHPs require indoor space – generally in a plant room.

WSHPs run at lower temperatures than conventional boilers, and so are well suited to under-floor heating systems and for radiators.

For WSHPs, the heat transfer rate from the water is far greater than that in the ground or the air. Constant energy replacement is provided by the circulation of the water source.

For this option, hot water would be provided by a separate electric or gas hot water boiler. However, an additional tank would be used to pre-heat the domestic hot water (using excess heat from the WSHPs), thus reducing electric/gas load from the main hot water storage tank.

Option 2 – Air Source Heat Pumps

ASHPs work in a similar way to WSHPs except that they utilise energy in the air to generate useful heat. Heat from the air is absorbed into refrigerant which is pumped through a heat exchanger. Low grade heat is then converted to high grade heat by the compressor. The heat can be exchanged to water which can be used in a conventional wet heating system (air to water heat pump). ASHPs can also be used in reverse to generate cooling. ASHPs require outdoor space, and can also be roof mounted.

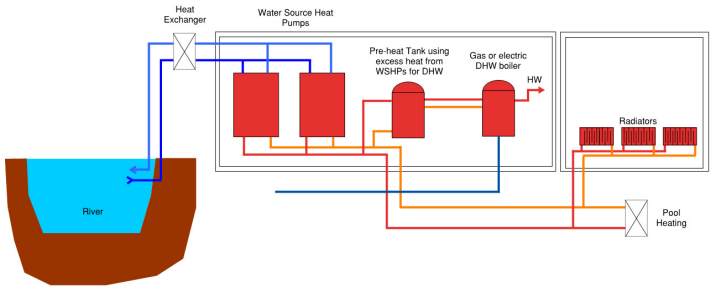
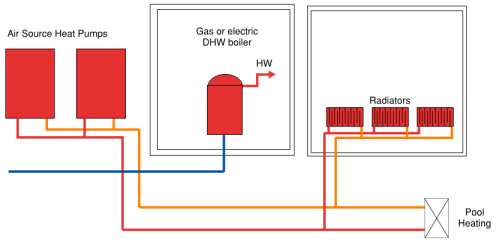
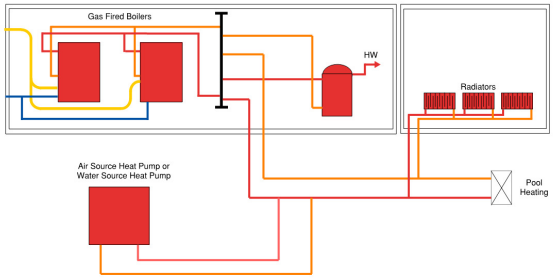
ASHPs run at lower temperatures than conventional boilers, and so are well suited to under-floor heating systems and for radiators.

For this option, hot water would be provided by a separate electric or gas hot water boiler.

Option 3 - Hybrid system – WSHP or ASHP combined with gas fired boilers

This option would combine a WSHP or ASHP with two conventional gas boilers. This option would allow the heat pump size to be reduced and the peak load covered by gas boilers.

Hot water would be generated directly from the boilers, using a hot water storage tank.

	1 – Water Source Heat Pumps	2 – Air Source Heat Pumps	3 – Hybrid System
Diagram			
Advantages	+ Higher efficiency than Option 2 & 3 (COP of 5) + Building Heating Load (except residential part) can benefit from Renewable Heat Incentive + Size of Plant – smaller than Option 2 & 3 + Very quiet system + Water rejected to river will be cool water and not heated water – less harmful for the biodiversity + Invisible – no flue and will be located in enclosure + No gas connection required (all electric) + If pools are only open in warmer periods of the year, this will increase the efficiency of the system as river water is warmer + Additional tank pre-heats DHW tank decreasing the hot water electrical load	+ Higher efficiency than Option 3 (COP of 3) + No Gas connection required (if an electric DHW boiler is chosen) + No flue required + Building Heating Load (except residential part) can benefit from Renewable Heat Incentive	+ Lower Capital Cost compared to Option 1 & 2 + Resilience + Cheaper installation than option 1 & 2
Disadvantages	– Extraction license and discharge required from the Environment Agency – Complexity – filtration of water system – Capital Cost	– Noise of Air Source Heat Pump could be a nuisance for the people at the pools – Has to be located externally – aesthetic issue – Capital Cost – More plant space required compared to Option 1 & 3	– Higher running cost than Option 1 & 2 – Gas Connection Required – Flue required – More Carbon intensive than Option 1 – Complexity of pipework/arrangement
Indicative cost/system*	Capital Cost : £150,000 including installation Running costs: £23,000** *Running Costs may be increased slightly due to Environment Agency license costs (Costs TBC)*	Capital Cost : £105,000 including installation Running costs: £32,000**	Capital Cost : £80,000 including installation Running costs: £45,000**
Appropriate?	Yes	Noise & location of system could be an issue	Yes – however flue from boiler may be an issue, and ASHP disadvantages (if chosen)

* Indicative based on 2016 cost rates, they do not take into account impacts of significant variations on the utilities that price variations that these may create.

** This figure is based on a calculated annual energy demand of 800,000 kWh and will depend on factors such as number of people, hours of use, pool cover use etc.

CONCLUSION

When considering Cleveland Pools, it is noted that there will be a fairly high and constant swimming pool heating load. This gives scope in using water source heat pumps.

It is proposed that water source heat pumps are more suitable in this instance, as they are very efficient (low running costs), discrete and quiet (which is very beneficial for this type of activity) in comparison to the two other options. Although the capital costs will be higher than the option 2 & 3, the low running costs make it a viable option economically. When comparing WSHPs to option 3, the payback period is only 3.5 years.