Open Loop Systems

In open loop systems, water is abstracted directly from (and discharged to), boreholes, rivers, lakes, ponds or even the sea and used as the heat source for a heat pump.

Open loop systems (depending on the type) can be cheaper to install than other types of heat pumps as there is no requirement for digging trenches. Also due to the higher constant temperature of the water source efficiencies are slightly higher.

However there are a number of points which need to be taken into consideration and these include permission from the Environmental Agency, which include but are not limited to:

In order to drill or test pump a water supply borehole, you will require a consent to investigate a groundwater source under section 32 of the Water Resources Act. To operate an open loop scheme you will need an abstraction licence (if the abstraction is greater than 20m^3/d) and an environmental permit to discharge water.

In addition to permission requirements you should consider the design of any scheme to ensure its longevity and efficient performance. Such design considerations are the responsibility of the operator, designer and installer of the scheme.

Facts at a glance:

- Installation

Open loop systems can be cheaper to install than digging trenches if a readily available water source is used.

- Efficiency

Open loop systems can have a higher efficiency than ground arrays due to the higher water source temperature.

- Licences

When extracting or drilling boreholes for extraction the Environmental Agency needs to be consulted for the appropriate licences.

- Freezing

To avoid freezing the water around the heat pump heat exchanger, an intermediate heat exchanger should be used to separate the circuits. Temperature of the source should be a minimum of 6^{o}C at all periods throughout the year.

- Filtration

With open source there is a requirement for filtration and additional maintenance issues, which must be addressed.

- Pond mats

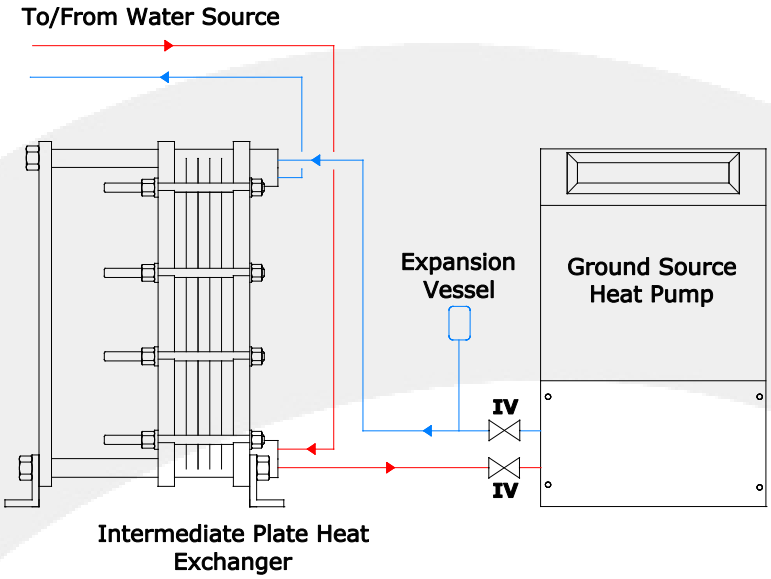
To reduce maintenance it is possible to use a pond mat system, where pipe is connected to mats and submerged to the bottom of an open water source such as a lake.

Consideration should be given to the following points:

- Employ the services of a professional hydrogeologist and/or groundwater engineer to ensure you have a well-designed open-loop GSHC scheme;
- Ensure that, in a twin borehole system there is adequate separation of the abstraction and discharge boreholes to ensure that large quantities of discharged water do not feed back Into the abstraction borehole affecting the temperature of the abstracted water and hence performance of the system;
- Ensure the discharge borehole is well designed so that it does not clog within a short period of operation. Careful control of the gas content, water chemistry and the particulate content of the water is required as small bubbles of gas and particulates can result in rapid clogging of the borehole or aquifer. Biofouling with bacterial growth can also become problematic.
- The hydraulic efficiency of the scheme will reduce over time, even with a good design, due to the clogging of the face of discharge as detailed above and especially if thermal breakthrough occurs between the abstraction and discharge boreholes. Background temperature of the groundwater may also change over time if more schemes are constructed in the area.

To avoid possible freezing and corrosion of the heat pump it is advised that the heat pump and water source are separated by an Intermediate plate heat exchanger as shown below. It is also important that the water is filtered and bacterial growth minimised to avoid fouling. This does mean that a regular maintenance schedule is required.

The signal for the extraction pump can be taken (via a relay) from the 240V supply from the ground side pump, contact Kensa Heat Pumps for further details. A check valve is also required on the water source side to ensure that the system does not drain down when the extraction pump is turned off.



Open Loop Questionnaire

In order that the application can be checked for it's suitability as a open loop installation, please complete the short questionnaire below.

Type of water source	Stream / River		Lake / Pond	Borehole
Stream / River Systems				**Comments**
Dimensions	Average width (m)	_____	Average depth (m)	_____ Use a stick to measure depths across the width.
Is there flow all year round?			Yes / No	
Estimated Flowrate	Summer (m^3/h)	_____	Winter (m^3/h)	_____ The methodology for this can be found on the inter-net or contact Kensa
Lake / Pond Systems				
Dimensions	Surface area (m^2)	_____	Average depth (m)	_____
Visible flow in and out of the lake / pond?			Yes / No	Is water flowing in and out of the lake / pond?
Borehole				
Depth (m)	_____		Expected flowrate (m^3/h)	_____

Application (AIS)

Kensa Heat Pumps
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AIS—Open Loop Systems – 5.0

Page(s)

General		Comments:
Minimum Annual Water Temp (°C)		Please specify what time of year this was measured .
Maximum Annual Water Temp (°C)		Please specify what time of year this was measured .
Depth (If surface water) (m)		
Discharge position of source water (i.e. downstream of water extraction point)		
Have permissions been sought?	Yes / No	i.e. Has the owner of the lake or river given consent? Does the Environmental agency need to be informed?
Pump (If fitted or specified)		
Proposed accessibility of intermediate heat exchanger		The intermediate heat exchanger may require to be cleaned periodically so should be accessible.
Distance from manifold? (m)		This is the distance from the manifold to the entry point of the header pipes into the water.
Distance from plantroom? (m)		This is the distance from the plantroom to the entry point of the header pipes into the water.

As an alternative to open loop it is possible to place the ground loops directly in the water source mounted on mats, called pond mats. This removes the need for an intermediate heat exchanger, removes the filtration issues and allows the use of antifreeze within the system to avoid problems with freezing.

With pond mats there are issues which need to addressed and these include:

1. Protecting the pond mats from damage (waves, debris, boats, propellers etc.);
2. Physically securing the pond mats against tidal current and waves;
3. Corrosion of the frame, mountings and structure;
4. Marine fouling.

A good place to install pond mats is mounting them to the underside of a floating pontoon.

Please complete the pond mat survey form to ascertain suitability.

Sketch of Water Source/Proposed