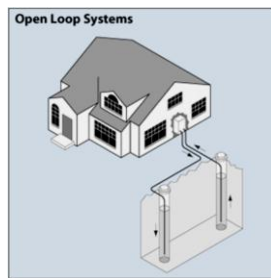
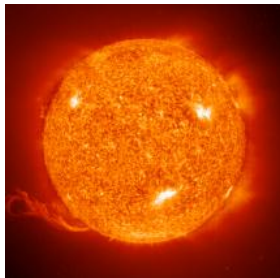


GROUNDWATER SOURCE HEAT PUMPS CAPABILITY STATEMENT

Background

Large parts of the UK are underlain by aquifers which could provide highly efficient renewable ground source heating and cooling schemes (capacity 100-600 Kw and above). Hafren Water can provide a feasibility assessment indicating to what extent fortunate businesses and community schemes can benefit from this natural resource.

Groundwater open loop systems draw water from a borehole, transfer heat to or from the water and then return it to the ground via injection wells or discharge direct to a surface waterbody.



Groundwater systems typically combine both heating and cooling applications with high efficiencies, typically in excess of 550% (COP >5.5). Passive cooling is straightforward with average UK groundwater temperatures of ~10°C. Typical borehole yields from UK aquifers range from 5 l/s to 30 l/s with applications in the range 100-600 Kw and above. The number of boreholes required for an open loop system is typically less than the equivalent closed loop system.

Drivers for GSHP

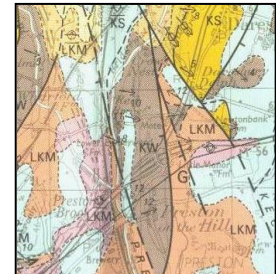
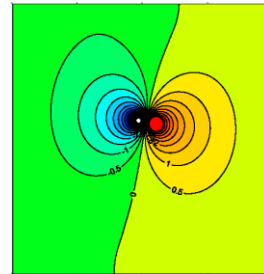
The proposed implementation of the Renewable Heat Incentive (RHI) scheme in April 2011 will greatly increase the cost-effectiveness of open loop systems. Payments of 5p/Kwh for 45-350 Kw systems are proposed over a 20-year period. Potential pay-back periods of 5-10 years have been calculated for appropriate groundwater source systems. Boreholes could also be used for water supply with associated cost and CO₂ savings.

Large reductions in CO₂ emissions are possible using a groundwater system for both heating and cooling applications. The Carbon Reduction Commitment will be implemented from April 2010. Qualifying large energy users will be required to annually report their carbon emissions to the government and join a cap-and-trade scheme incentivised with financial benefits and penalties.

Services

Hafren Water specialises in the investigation and assessment of groundwater and surface water. We have expertise in the design of ground heat exchangers and provide independent advice to energy consultants, property developers, planners, and heat pump installers. Our phased input increases confidence at each stage of the proposal, minimising project risk and expenditure. A summary of the services we offer is given below.

- Open loop feasibility studies
- Environment Agency liaison and permitting
- Groundwater and surface water assessments
- Geological assessment
- Energy assessment
- Borehole design
- Groundwater quality assessments
- Pumping tests
- Ground thermal modelling
- Array design (open and closed loop)
- Basic technical or full detailed reporting
- Management of drilling and installation
- Impact assessment on water supplies and springs



Suitability for a Groundwater Open Loop System

Not all locations are suitable for groundwater-based systems. An aquifer is required within a suitable depth (usually <150 m) of the surface. Typical UK aquifers comprise shallow sand and gravel deposits, sandstone or limestone; regional aquifers include Chalk around London and the Southeast, Triassic Sandstone in the Midlands and Northern England, Carboniferous and Magnesian Limestone, the Coal Measures and old mine workings.

Open loop systems are potentially more complex than other alternatives, with performance dependent on testing of borehole yield. However, if implementation is managed in the correct way a highly efficient system can be installed for a minimum risk. Expenditure is undertaken in phases to assess and minimise the risk at each stage of the work before proceeding to the next.

GROUNDWATER SOURCE HEAT PUMPS CAPABILITY STATEMENT



A typical approach is as follows:

- Pre-feasibility - aquifer search, Environment Agency liaison
- Feasibility assessment – desktop study of hydrogeology, impact assessment, borehole design, energy and water features survey
- Drill and test boreholes
- Environment Agency Permitting
- Final array design and installation

Our independent feasibility assessment can form the basis of future tender negotiations. Consultation with the building M&E Engineers is maintained throughout the project to ensure the scheme meets the heating and cooling strategy for the building, incorporating sufficient flexibility to meet future changes. Underpinning the application for the abstraction licence and discharge consent is a good working relationship with the Environment Agency officers involved.

Hydrogeological assessment. We provide an assessment of the local geology and the potential groundwater and energy yield. Investigation prior to drilling can minimise costs and unexpected consequences of, for example, drilling into a confined aquifer, running sands or old mine workings. Different options for ground array design are considered together with CO₂ savings and payback. We combine our geological expertise with the capability to assess the building energy demands and the integration of these with other heating and cooling systems, using RETScreen software.

Hafren Water is highly experienced in permit applications and negotiations with the Environment Agency. We assess the impact of the proposed groundwater abstraction and discharge, plus how it will affect the thermal gradient in the vicinity.

Cost of assessments

We aim to minimise initial expenditure, whilst maximising confidence in the predicted system performance. Our charges for array design are based on a sliding scale, which takes into consideration the complexity and size of the installation. Results of the initial pre-feasibility study can be presented in a tabulated format, with a brief technical report. The next stage is a more detailed feasibility study incorporated into a comprehensive report for submission to interested parties (Client, Environment Agency, Installers). Subsequent to the feasibility study more accurate costs can be provided for later stages of the work. We would welcome the opportunity to provide a competitive quotation specific to your project needs.



Projects

Hafren Water undertakes feasibility studies for both open and closed loop systems throughout the UK. Assessments have included schools, commercial and residential complexes, a Cathedral and a major office building (2.5 Mw) in the City of London. We have recently undertaken the feasibility assessment, borehole design, testing and subsequent Environment Agency permitting for the new NWDA Science and Innovation Centre near Warrington. At this site up to 30 l/s will be abstracted to provide 375 Kw heating and 400 Kw of passive cooling from the Triassic Sandstone.

We provide independent advice on whether an open loop scheme is appropriate for your project and work with the installer to provide the optimum solution.

Clients

Work has been undertaken for a variety of ground source and water resource projects. Hafren Water has completed assessments for (amongst others):

- Northwest Regional Development Agency
- Yorkshire Water
- Severn Trent Water
- Nottingham University
- Tarmac Ltd
- Hanson Ltd
- Ecovision Systems
- Azure Natural Energy Systems
- Community Energy Solutions
- Energyworx
- Hurleypalmerflatt

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