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Shallow Geothermal Admissibility Maps: a Methodology to Achieve a Sustainable Development of Shallow Geothermal Energy with Regards to Groundwater Resources

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Implantation and use of shallow geothermal systems may have environmental impacts. Traditionally, risks are divided into 2 categories: direct and indirect. Direct risks are linked with the leakage of the circulating fluid (usually water with anti-freeze) of ground source heat pumps into the underground which may be a source of contamination. Indirect risks are linked with the borehole itself and the operation of the systems which can modify the groundwater flow, change groundwater temperature and chemistry, create bypasses from the surfaces to the aquifers or between two aquifers. Groundwater source heat pumps (GWSHP) may provoke indirect risks, while ground source heat pumps (GSHP) may provoke both direct and indirect risks. To minimize those environmental risks, the implantation of shallow geothermal systems must be regulated.

In 2007, more than 7000 GSHP have been installed in Switzerland, which represents 1.5 Mio drilled meters. In the canton of Vaud, each shallow geothermal project has to be approved by the Department of the Environment. Approximately 1500 demands have been treated during 2007, about 15 times more than in 1990. Mapping shallow geothermal systems implantation restrictions due to environmental constrains permits: 1) to optimize the management and planning of the systems, 2) to minimize their impact on groundwater resources and 3) to facilitate administrative procedures for treating implantation demands. Such maps are called admissibility maps. Here, a methodology to elaborate them is presented and tested.

Interactions between shallow geothermal energy and groundwater resources have been investigated. Admissibility criteria are proposed and structured into a flow chart which provides a decision making tool for shallow geothermal systems implantation. This approach has been applied to three areas of West Switzerland ranging from 2 to 6 km2. For each area, a geological investigation has been realized and complementary territorial information (e.g. map of contaminated areas) was gathered in order to produce the admissibility maps. For one area, a more detailed study has been performed and a complete 3D geological model has been constructed using an in-house modelling software called GeoShape. The model was then imported into a geographical information system which has been used to realize the admissibility map. Resulting maps were judged to be consistent and satisfying.

In a second part of the project, this method will be applied at a larger scale. An admissibility map of the canton of Vaud (3200 km2) will be created. Considering the fast growth of the number of implanted GSHP and GWSHP throughout the world, it is clear that admissibility maps will play a major role in developing shallow geothermal energy as an environmentally friendly and sustainable resource.