Université de Neuchâtel
Centre d'hydrogéologie
et géothermie

MSc in Hydrogeology and Geothermics

Thesis topic proposal 2024

Exploring the dynamics of horizontal wells

Context and objectives

Horizontal wells for groundwater abstraction are widely used in Switzerland. Horizontal wells offer several advantages, including high yield due to their ability to place laterals in layers with optimal permeability, resulting in lower pumping costs per unit of volume. They also create less and more evenly distributed drawdowns. Numerous analytical solutions to treat horizontal wells have been developed, but they are typically highly simplified in terms hydrogeological conditions (Houben et al., 2022). There is a research need to improve the quantitative treatment of horizontal wells. Specifically, the conditions under which the analytical solutions provide robust solutions are unclear. Moreover, the behaviour of horizontal wells close to rivers is poorly understood.

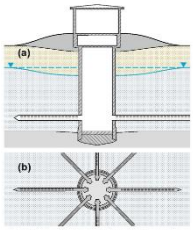

Figure 1: Typical set-up of a radial collector well: (a) cross-section, (b) plan view. Figure: Houben et al. 2022

Methodology

Project 1: The student will elaborate detailed numerical models explicitly representing horizontal wells in different hydrogeological conditions, e.g close to a river, heterogeneous aquifers or transient conditions. A wide range of different hydrogeological conditions will be implemented, including collector wells close to rivers, transient and heterogenous conditions. These conceptual models will be used to assess the veracity of the analytical solutions and will also be applied to the field data available in project 2.

Project 2: The second project addresses the same questions, but with a stronger field component. The project will focus on the Wehrliau horizontal wells near the Aare. At this site, a dense monitoring network including multi-level samplers are available. It will be investigated if the hydraulic and tracer response during pumping tests can be reproduced with models of different complexities (numerical model, simplified analytical models). For the numerical model, travel times from the river, which are highly relevant for water quality, will be evaluated in addition to hydraulic parameters.

While both projects are stand-alone, numerous synergies can be developed between these two master-thesis in terms of fieldwork and modelling.

Supervision and collaboration

The projects will be supervised by Prof. P. Brunner, Prof. D. Hunkeler .

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References

Houben, G.J., Collins, S., Bakker, M. *et al.* Review: Horizontal, directionally drilled and radial collector wells. *Hydrogeol J* **30**, 329–357 (2022). https://doi.org/10.1007/s10040-021-02425-w