# Managing the Deep Thermal Groundwater Body in the Lower-Bavarian-/ Upper-Austrian Molasse-Basin

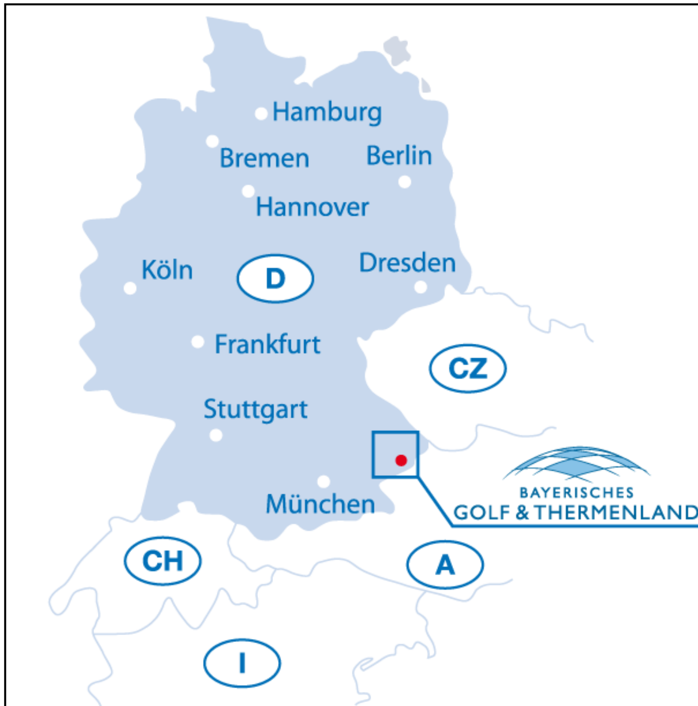
Workshop „Water allocation in transboundary basins“
Geneva, 16 – 17 October 2017

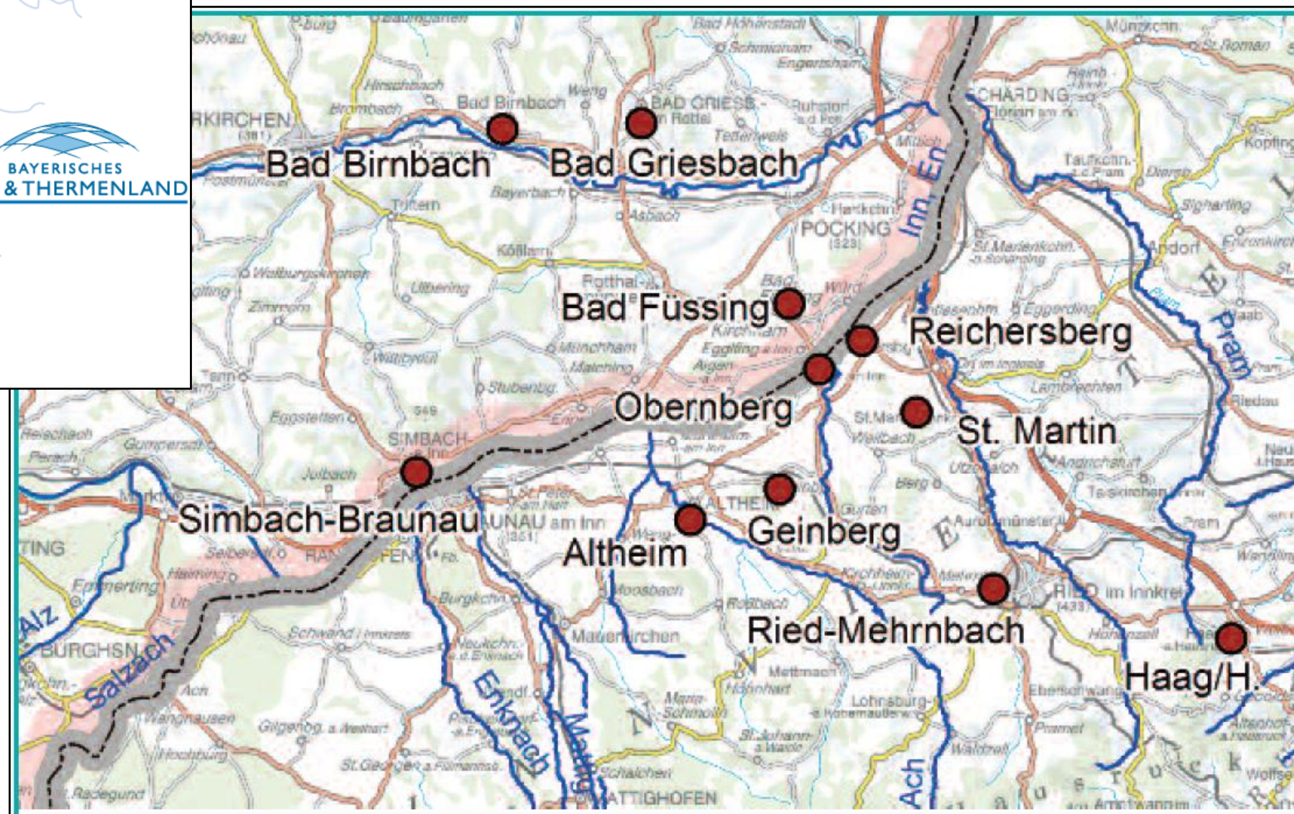
Michael Belau, Referat 57

# Outline:

- **Location and Historical Developments**
- **Setting up the frame for cooperation**
  - objective and legal framework
  - operational framework
- **Tools for sustainable management of thermal water resource (Groundwater-models)**
  - 2-D Groundwater Model
  - Guidelines for the use of thermal water in in the Lower-Bavarian-/Upper-Austrian Molasse-Basin
- **Sustainable management: Does it work in this case?**

# Geografical location (central area of geothermal aquifer):



# Lower-Bavarian Spa-Region - Impressions:

**Therme Eins Bad Füssing**

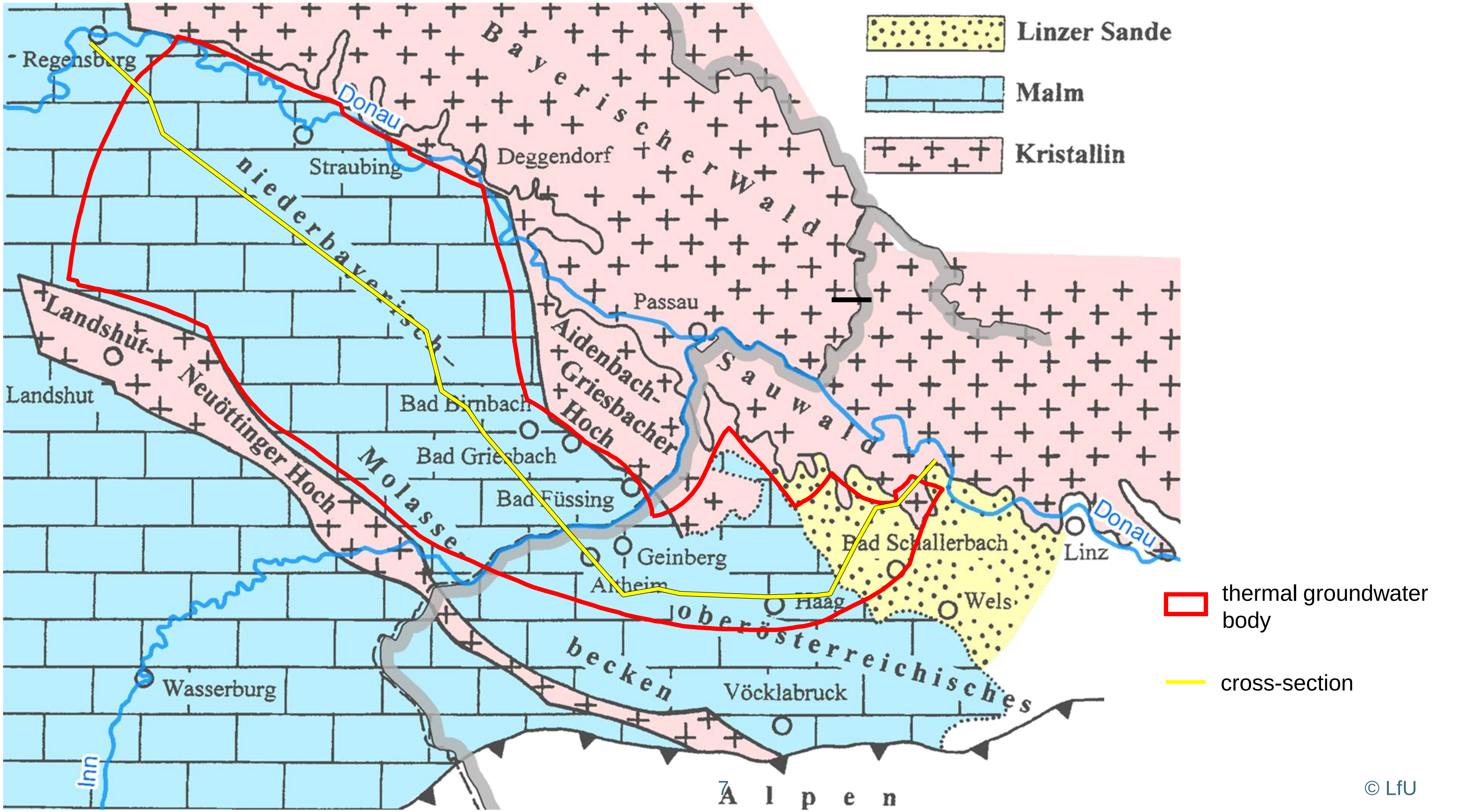
# Lower-Bavarian Spa-Region - Impressions:

**Europatherme Bad Füssing**

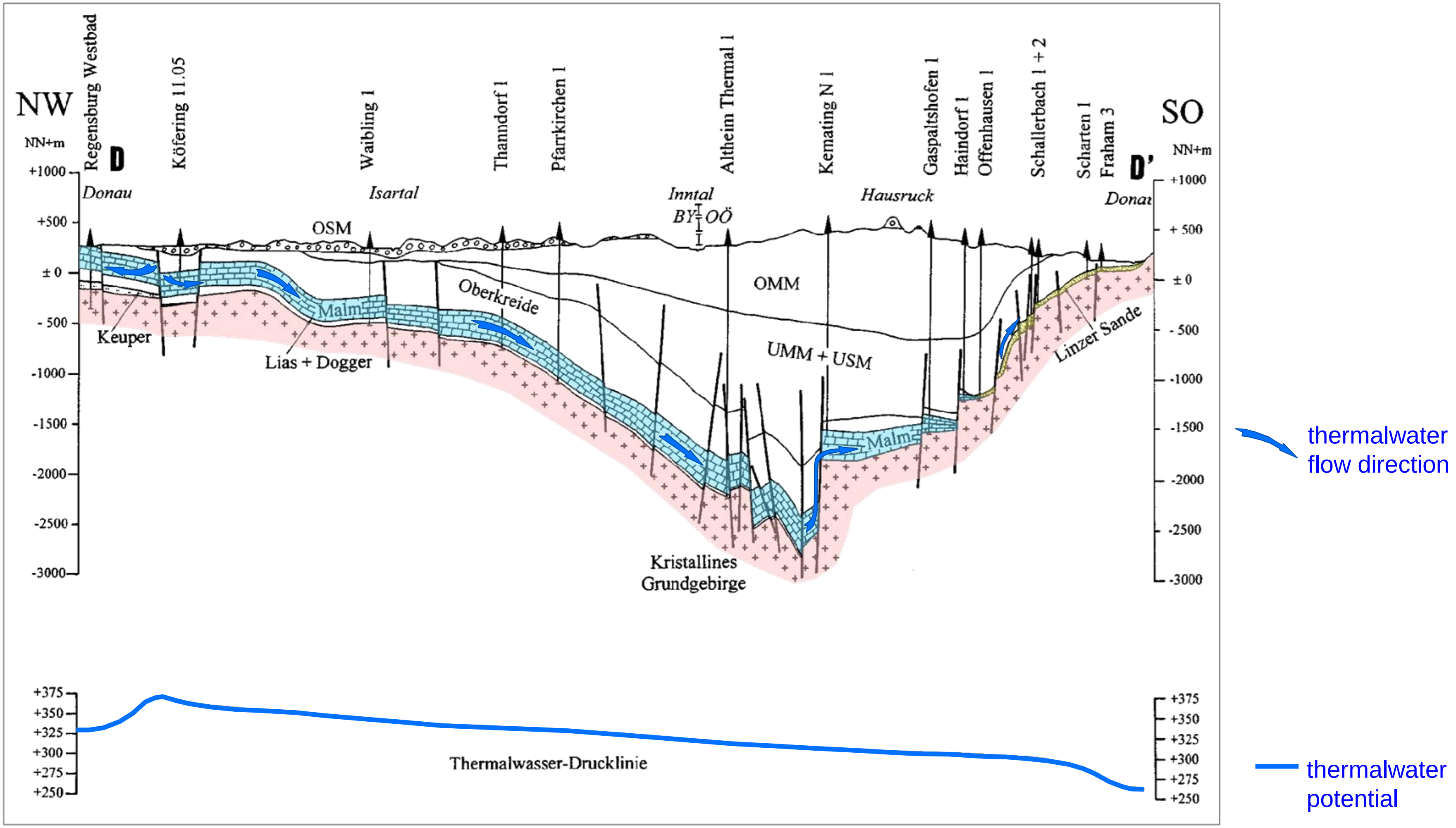
# Lower-Bavarian Spa-Region - Impressions:

**Johannesbad Bad Füssing**

# Geological overview (without cretaceous and tertiary overlying strata)



# Geological cross-section NW – SE, highly exaggerated



# Most important historical developements

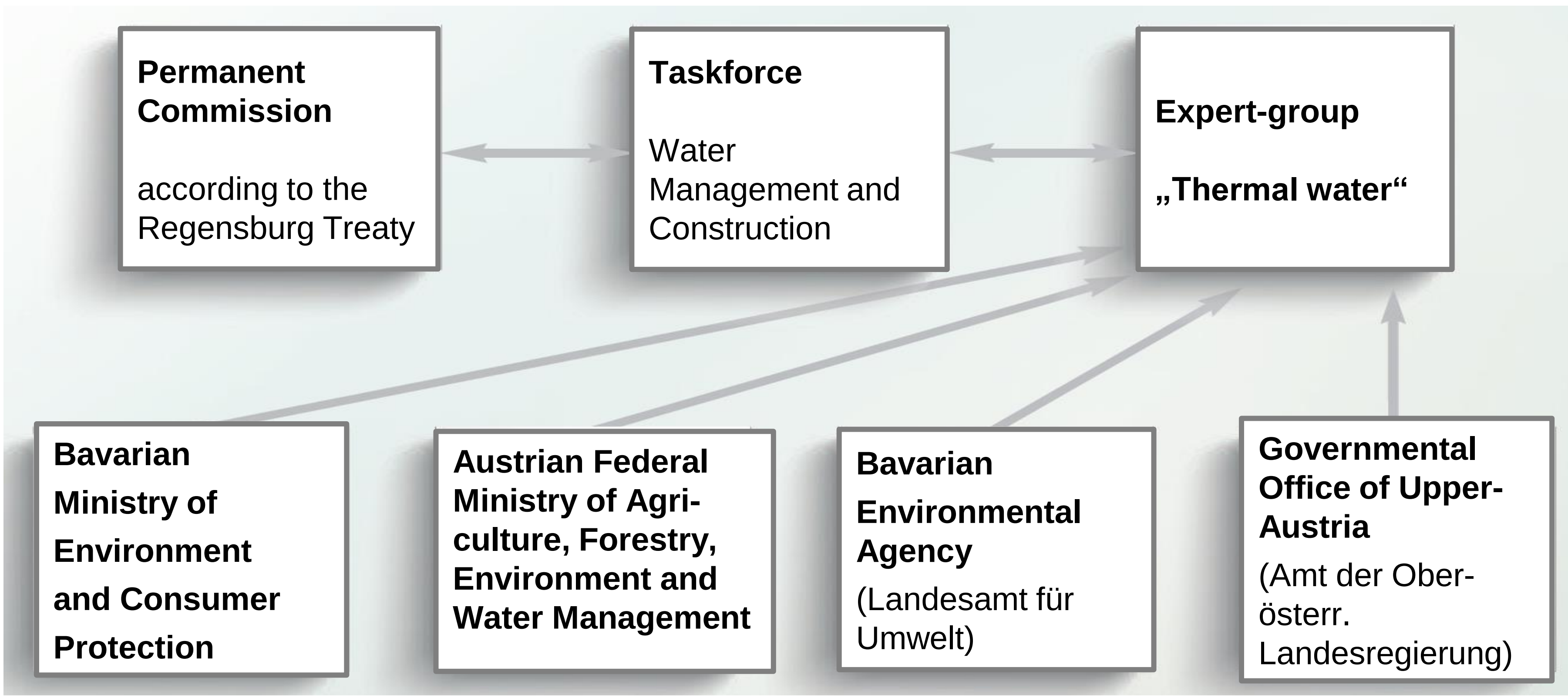
- **1938:** first well in Füssing
- **1947:** first temporary bathing facilities in Füssing
- **1953:** An expertise by the University of Munich attested healing properties of thermal water.
- **1963/64:** Second and third well in Füssing. Artesian thermal water was found in both wells.
- **1969:** Füssing became „Bad" Füssing
  → possibilities to cure and prevent deseases by applications with thermal water were officially recognized and appropriate infrastructures were promoted
- **1973:** well-drillings in further locations
- **1988:** With an accommodation capacity of 13.300 beds and ca. 3,2 Mio. overnight accommodations, Bad Füssing reached the peak.
- **1990:** start of exploitation in Austria for geothermal purposes, excellent geological setting

Situation starting in 1990: The exclusive use for **geothermal energy in Austria** is limited by the exclusive use of thermal water for **balneological purposes** in Germany BY)

→ A sustainable, harmonised management in close cooperation is needed to ensure that the thermal groundwater is not overstressed

# Setting up the frame for cooperation – Objective and legal framework

- Objective: sustainable management in close cooperation between D and A
- Legal framwork: **Regensburg Treaty (1987)** on Water Management Cooperation in the Danube River Basin.



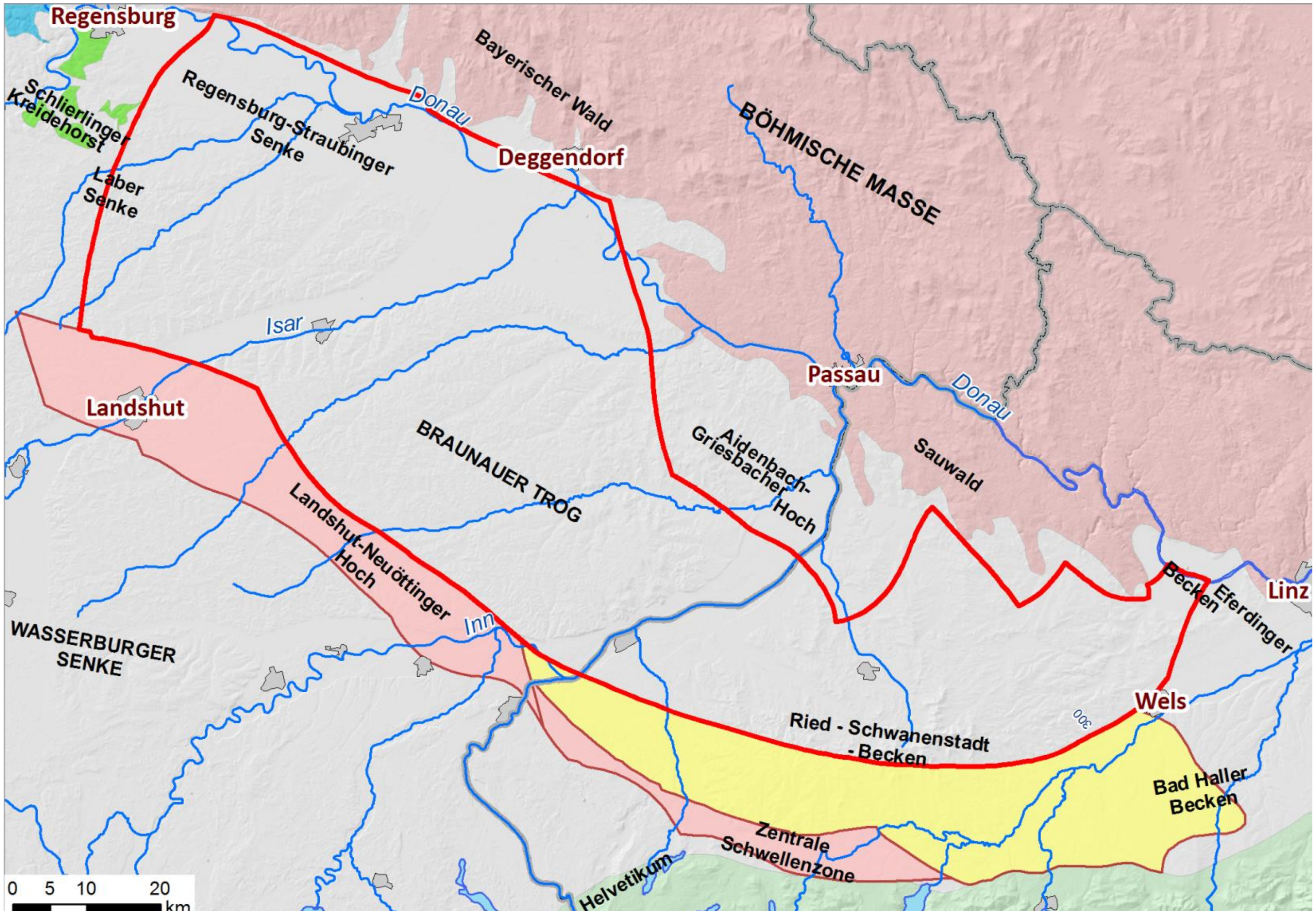
# Setting up the frame for cooperation – operational framework

- 1989/90: Establishment of the ad-hoc-group ”Deep Water“ to ensure a sustainable management of the thermal groundwater-body based on:
  - scientific knowledge,
  - balanced monitoring and
  - appropriated tools
    in particular: 2D groundwater model with the objectives to describe and balance the transboundary Groundwater-body

  → Incorporate strategies on how to manage the Groundwater in terms of quantity and quality („Guidelines for the use of thermal water in in the Lower-Bavarian-/Upper-Austrian Molasse-Basin)

- 2002: Ad-hoc-group „Deep Water“ was renamed in **Expert-group „Thermal Water“**

# Tools for sustainable management of thermal water resource: 2D - Hydraulic Groundwater-Model (building up from 1995 to 1998)




**Model Boundarys**

**Flow Direction and Sources and Sinks**

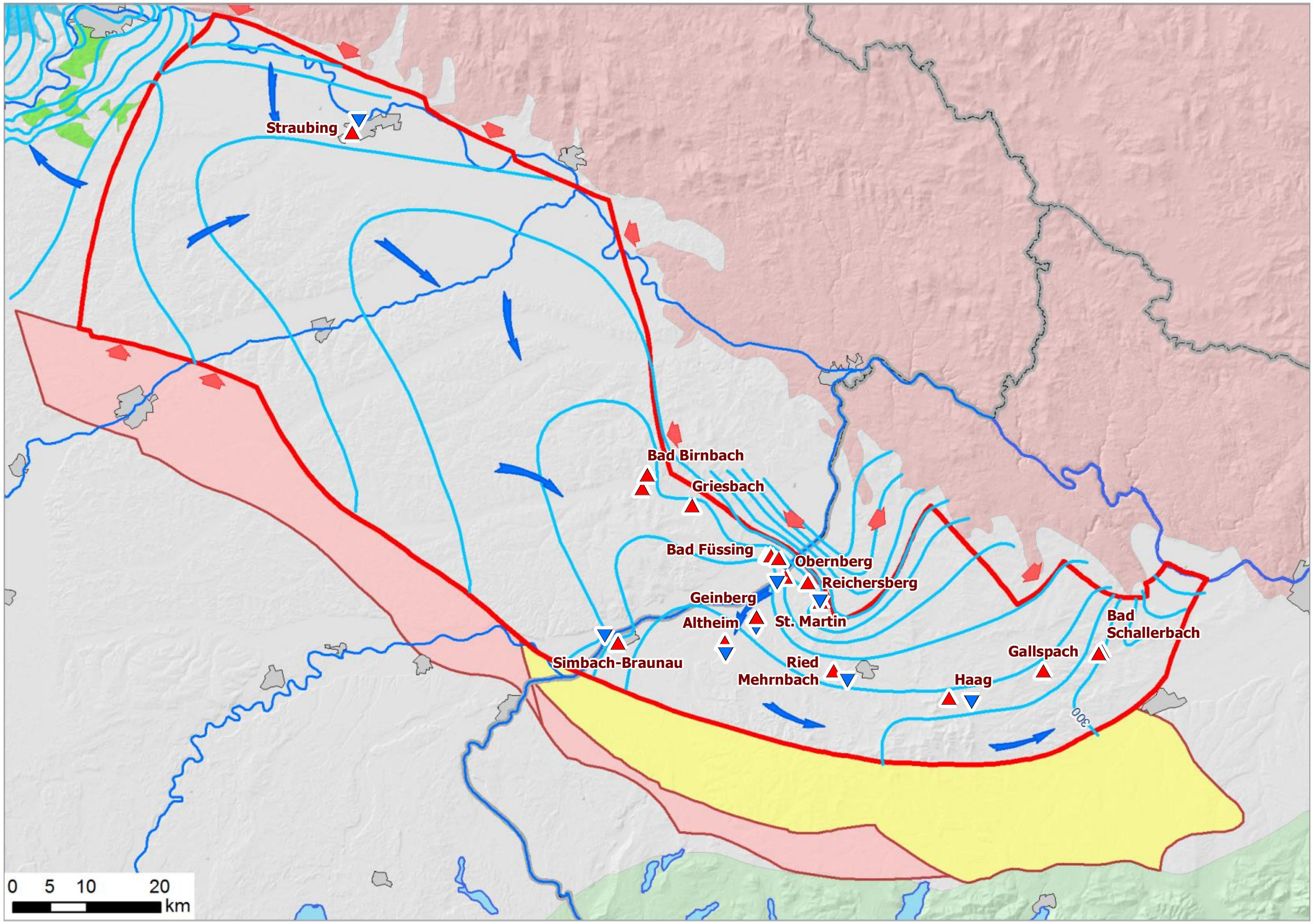
**Thermalwater Budget Components**

model boundary

**Surface Geology**
- quarternary, tertiary
- cretaceous
- upper jurassic
- alpine nappe
- crystalline rock

**Deep (Hydro-)Geology**
- crystalline rock
- high salinity in thermalwater-aquifer

# Tools for sustainable management of thermal water resource: 2D - Hydraulic Groundwater-Model (building up from 1995 to 1998)




Model Boundarys

**Flow Direction and Sources and Sinks**

Thermalwater Budget Components

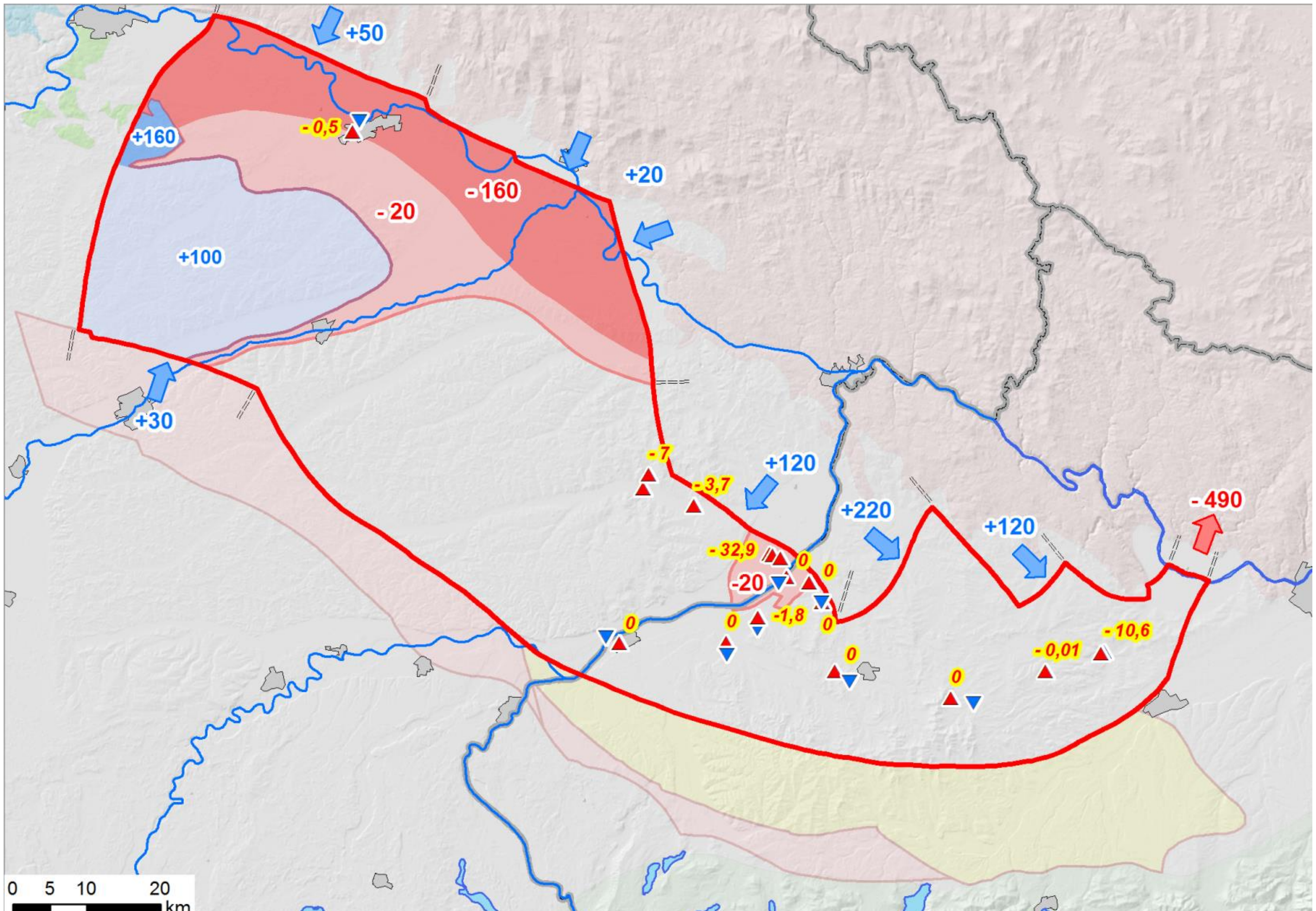
**hydraulic head / potential [m asl]**

- contour line interval: 10m
- thermalwater flow direction
- influx from crystalline
- model boundary

**thermalwater site**

- extraction
- re-injection

# Tools for sustainable management of thermal water resource: 2D - Hydraulic Groundwater-Model (building up from 1995 to 1998)




Model Boundarys

Flow Direction and Sources and Sinks

**Thermalwater Budget Components**

model boundary

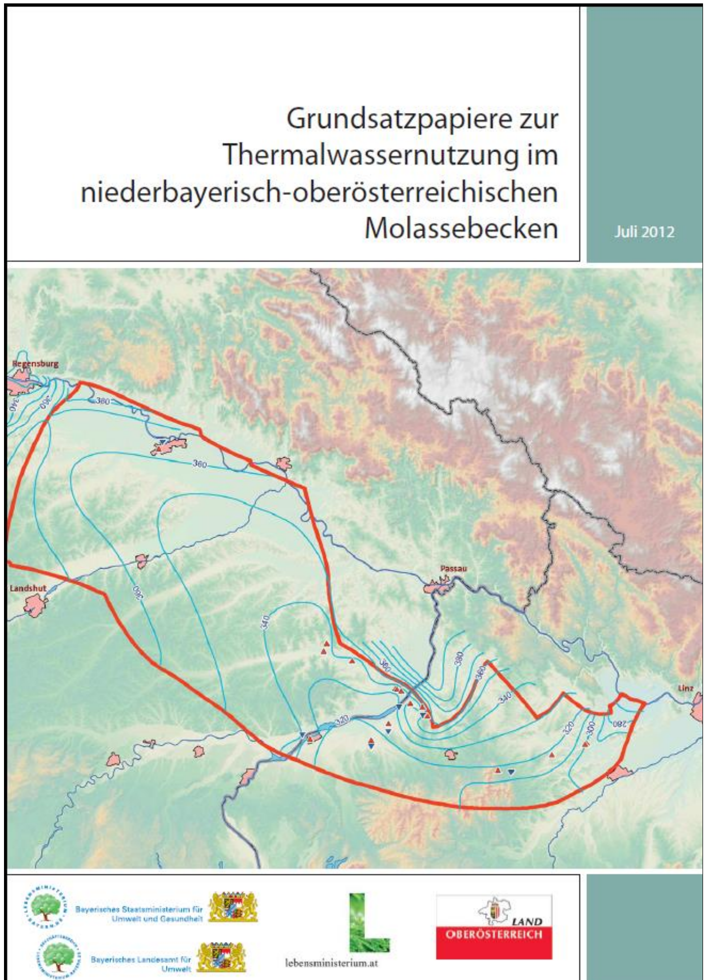
**fluid flow at boundary**
influx
outflux

**recharge**
+ 100 l/s
+ 160

**discharge**
- 20 l/s
- 160

**extracted thermalwater [ l/s net 2015 ]**
extraction
re-injection

# „Guidelines for the use of thermal water in in the Lower-Bavarian-/Upper-Austrian Molasse-Basin"




→ **… to be found on: www.lfu.bayern.de**

# Guidelines for the use of thermal water in in the Lower-Bavarian-/ Upper-Austrian Molasse-Basin:

- Provide technical harmonized regulations concerning exploitation, monitoring and further work-steps help to
  - receive annual status reports with standardised exposures and compiled measurements, which easily can be read and interpreted,
  - generate a data pool for modelling purposes,
  - describe the (qualitative and quantitative) status of the Groundwater-body as claimed by the European Water Framework Directive („Wasserrahmenrichtlinie“) and to
  - Solve the daily questions the authorities deal with

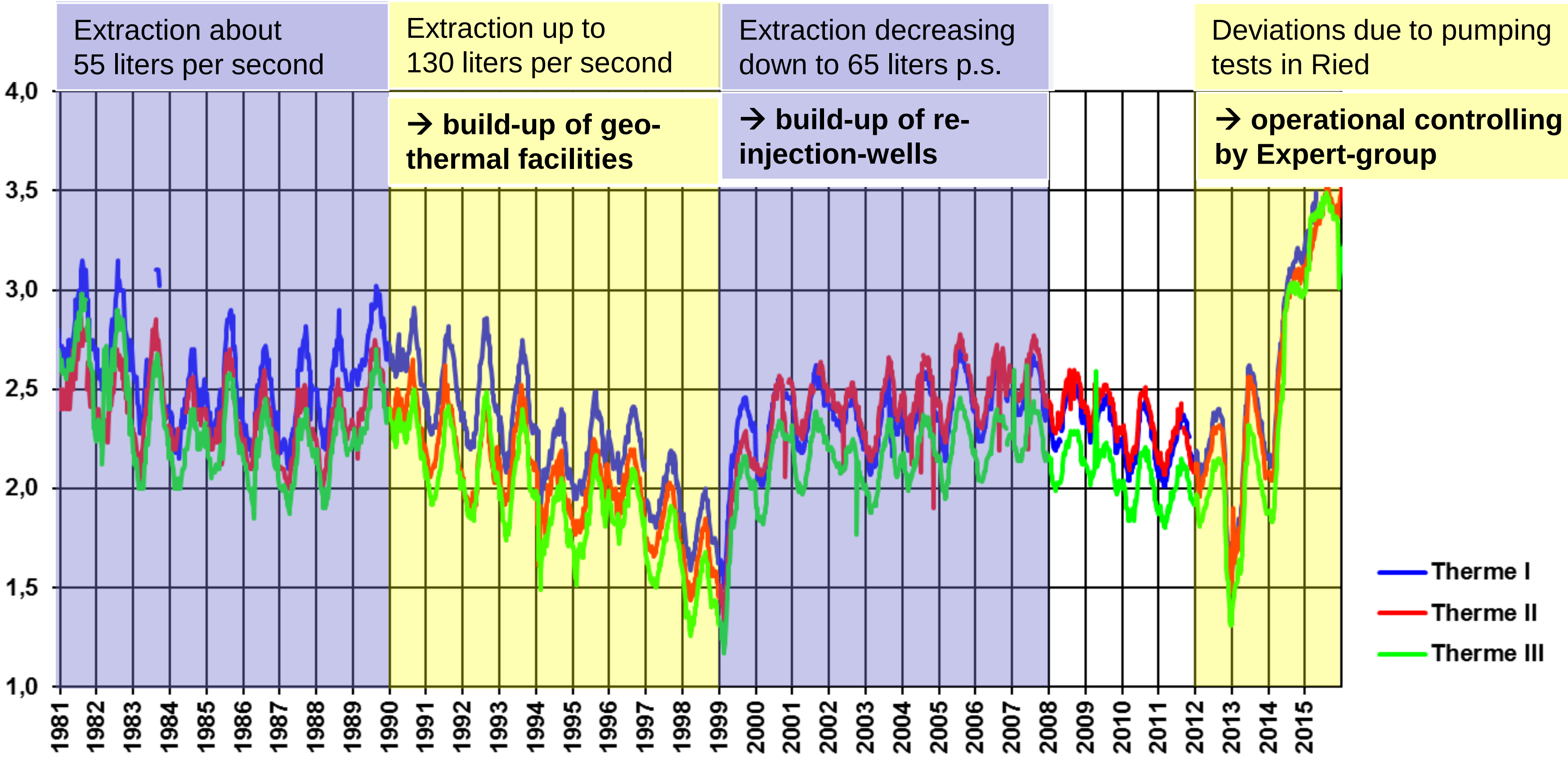
- One important objective is to keep the natural pressure regime in the Groundwater-body.
  - → Reinjection of the water after geothermal use  by reinjection well (which is located in the same Groundwater-body)
  - → As balneologically used water must not be reinjected, **it must be strictly garantueed, that the used amount of water doesn‘t exceed the calculated demand.**

# Calculating an appropriate demand of water (page 28):

| Fields of application | Therapeutic purpose | | | Wellness purpose | Leisure purpose | EXTERNE KUR- und THERAPIE-BEREICHE |
|---|---|---|---|---|---|---|
| **Betriebsweise** | Kreislauf-betrieb | Durchlauf-betrieb | Füll-betrieb | Kreislaufbetrieb | Kreislaufbetrieb | Spezifische Bemessungs-größen je nach Anwendungs-bereich |
| **Beckengröße** | bis 100 m³ | bis 40 m³ | bis 400 l | | | |
| **Specific demand** | 150–200 l pro Person und Tag | 4 m³ pro Person und Stunde | | 120–150 l pro Person und Tag | 60–120 l pro Person und Tag | |
| **Austauschzeit** | 1–3 Tage | | | 7–10 Tage | 15 Tage | |

# Sustainable management: Does it work in this case?

## Wellhead pressures (close-in pressures) in the central area:



# Further information:

**Guidelines for the use of thermal water in in the Lower-Bavarian-/ Upper-Austrian Molasse-Basin**

- **www.lfu.bayern.de/wasser/thermische_nutzung/doc/thermalwasser_grundsatzpapier.pdf**

**Hydraulically-thermally coupled 2D-Groundwater-model in the deep aquifer of the Lower-Bavarian-/ Upper-Austrian Molasse-Basin**

- **www.lfu.bayern.de/wasser/thermische_nutzung/doc/thermalwasser_molassebecken.pdf**

**Basic investigations regarding thermic effects caused by the use of thermal water in Lower-Bavaria/ Upper-Austria**

- **www.lfu.bayern.de/wasser/thermische_nutzung/doc/kurzbericht_thermal.pdf**

# Thank you for your attention!

# Main Results of the 2D – Hydraulic Grounswater Model:

- currently no over extraction of thermal water from deep groundwater-body
- frame for thermal water allocation in central area is limited by 20-25% of the existing thermal water budget
- effects of future extractions/ re-injections on the thermal water budget and potential can be forecasted
- a total re-injection of thermally used water is mandatory

# Hydraulic-Thermal Coupled 3D Groundwater-Model (central area):

Will the intensive geothermal use (with re-injection wells) result in an large-scale lowering of thermal water temperatures and existing pressure conditions and put this the balneological use into question?

**Investigations: 2005 to 2008 (EU-cofinanced)**

Interreg IIIA-project “Basic investigations regarding thermic effects caused by the use of thermal water” including the **local hydraulic-thermal coupled 3D Model** in the central area.

**Main Results (regarding the central area):**

- Geothermal uses cause only a limited local thermal impact.
- Hydraulic effects of water use for balneological purpose are much larger than thermal effects caused by reinjection (thermal purpose)

→ No need to couple the new 3D – Hydraulic Groundwater Model with a thermal model

# Findings and Lessons Learned:

**→ Consider and follow formal needs …**

- … by reporting to superordinated committee and receiving resolutions
- … by allocating human resources by employers
- … related to applying for and spending public budget resources

**→ Safeguard the quality of work, for example by …**

- … development and maintaining of adequate forecasting tools
- … involving a wide range of different professions
- … permanent harmonised monitoring and logging of data

**→ Achieve acceptance from outside, by …**

- … getting to know economical facts and aims particularly regarding the launching and developping of economical projects
- … aiming to achieve consensual solutions, thinking about the possibility to address cases of controversy or fundamental questions/ decisions to superordinated committee(s)
- … emphasizing the loyalty of members to official legal framework and independence from interests of parties standing on the outside