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November 28th 2007, Litomyšl

Application of the MAGIC approach in Stuttgart

Municipality of Stuttgart
Department for Environmental Protection
Dipl.-Ing. Hermann Josef Kirchholtes

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My presentation

1. MAGIC approach
2. Stuttgart
3. Project area Feuerbach
4. Initial situation
5. Objectives of our investigation activities
6. Preparation and implementation
7. First results
8. Final steps

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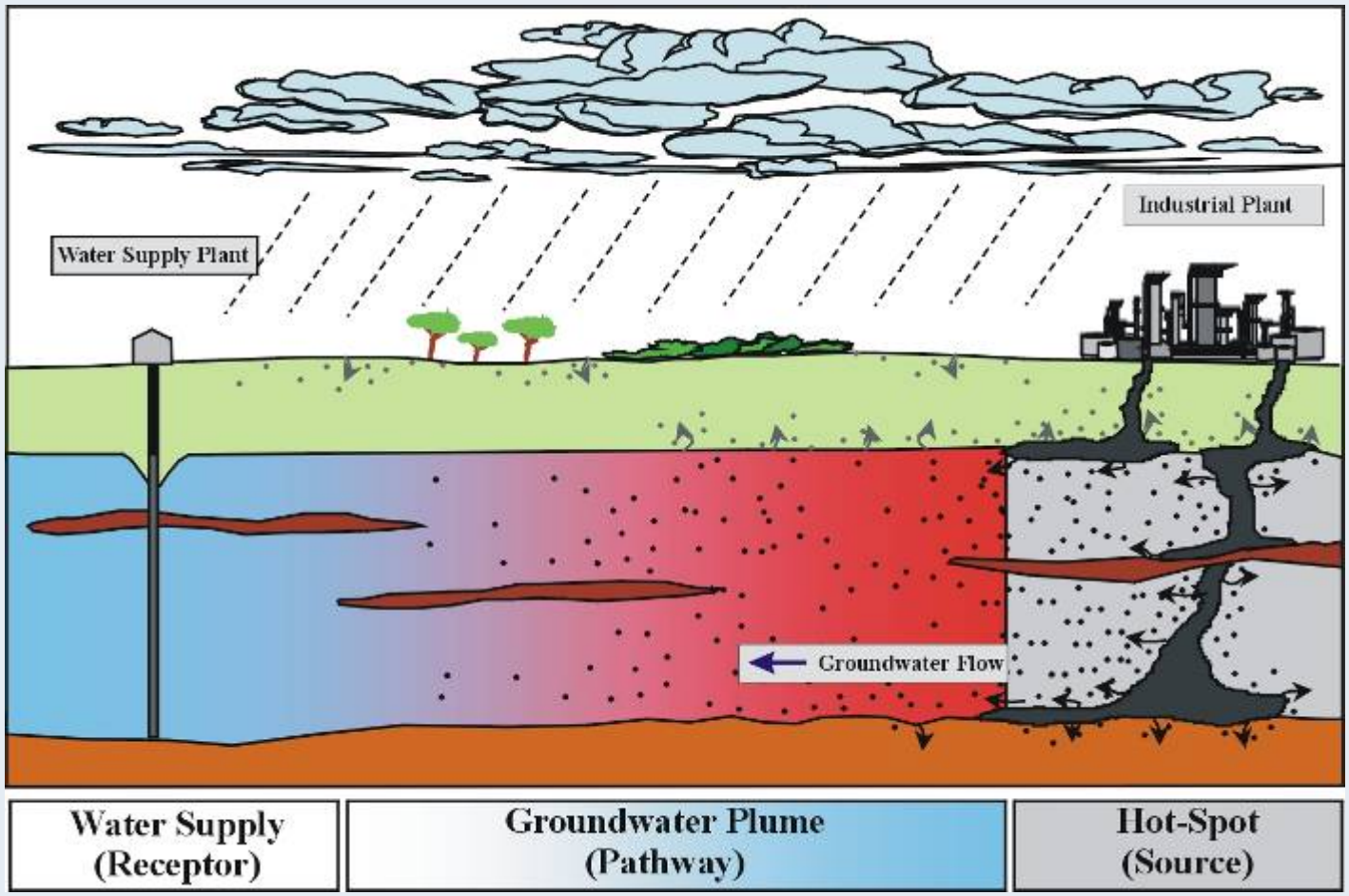
Sources and Plumes



adapted from: TEUTSCH/RÜGNER, 2000

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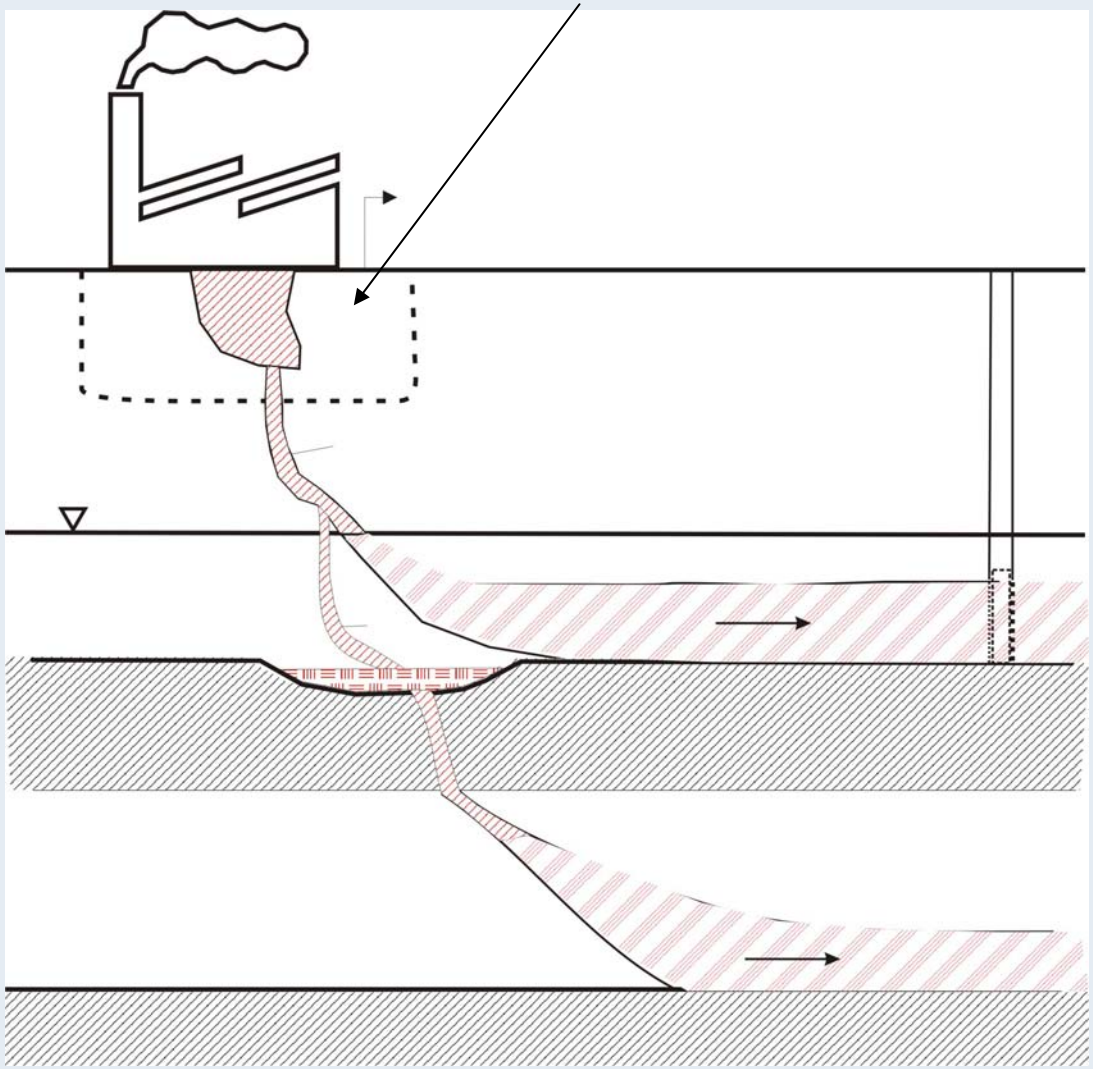
Source



Transmissivity

high

low

high

low

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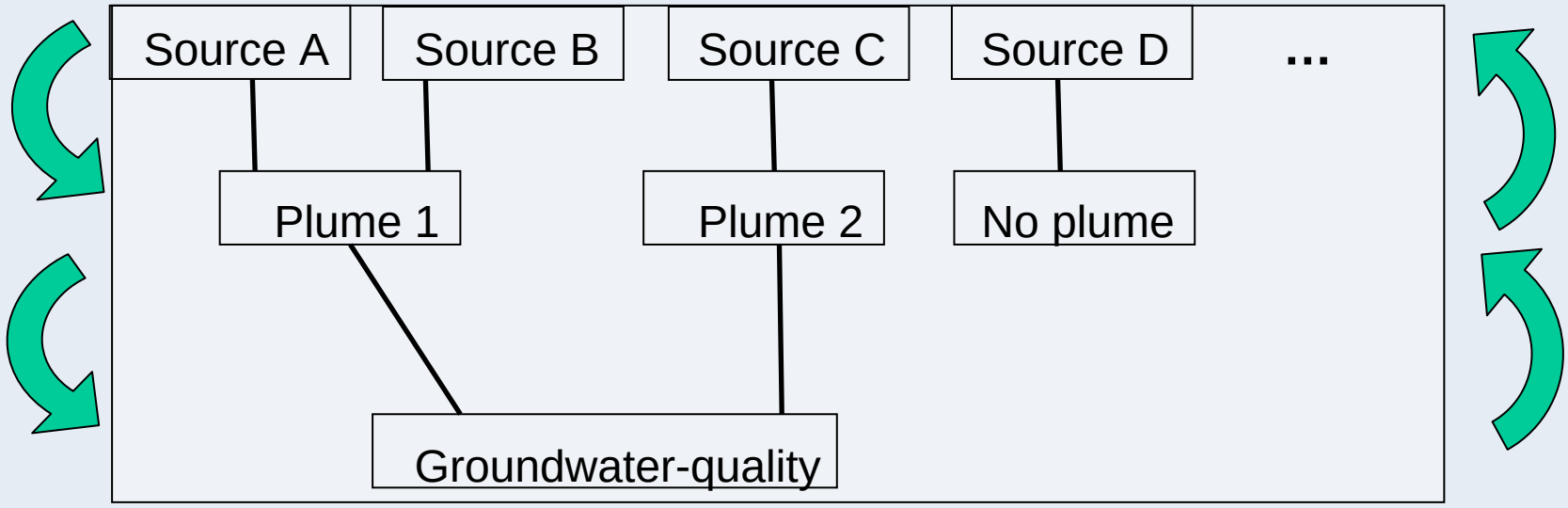
Site by site

MAGIC approach



Advantages of the MAGIC-Approach:

- Identification of core-sources of gw-pollution
- Concentration on the relevant sources
- Management of contaminated sites according to priority
- No further activities on secondary sources

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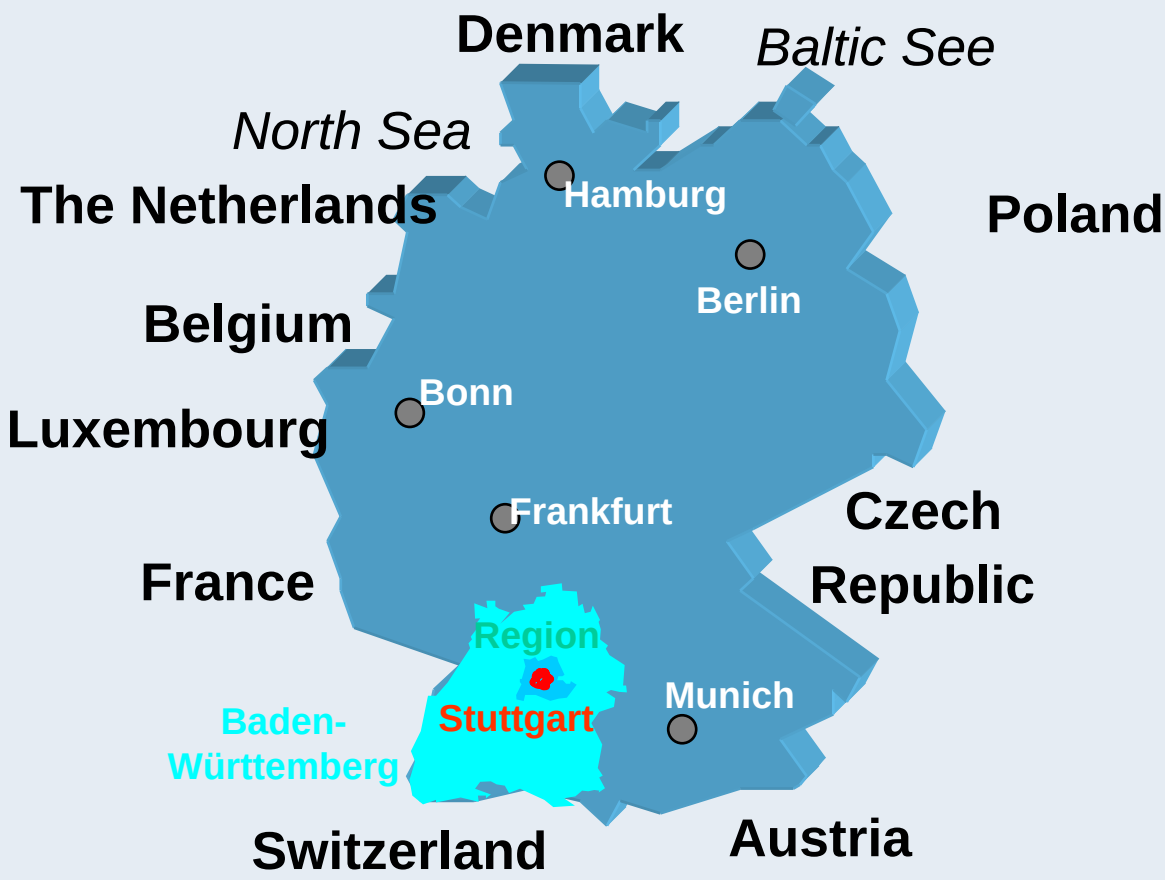
City of Stuttgart



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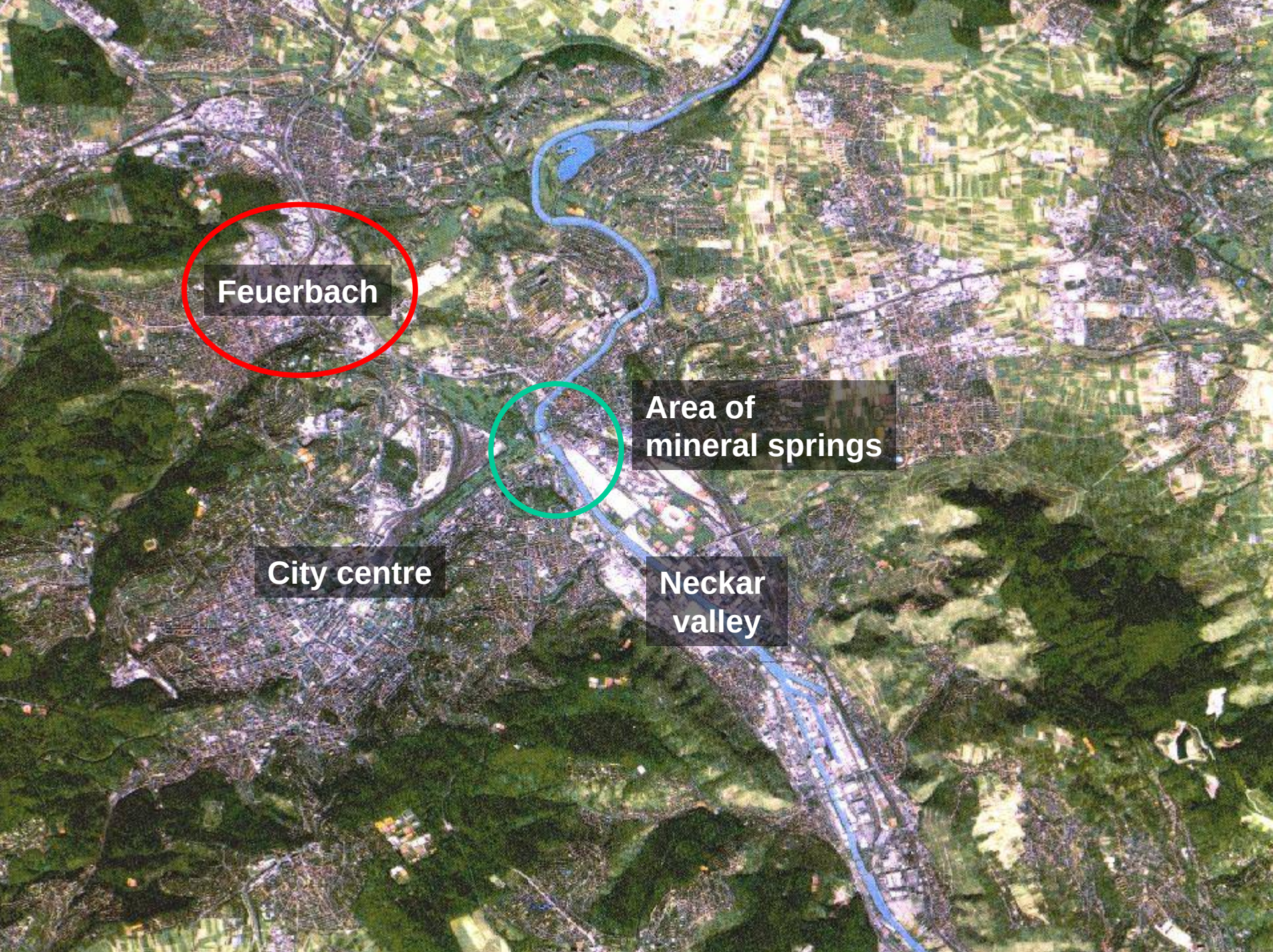
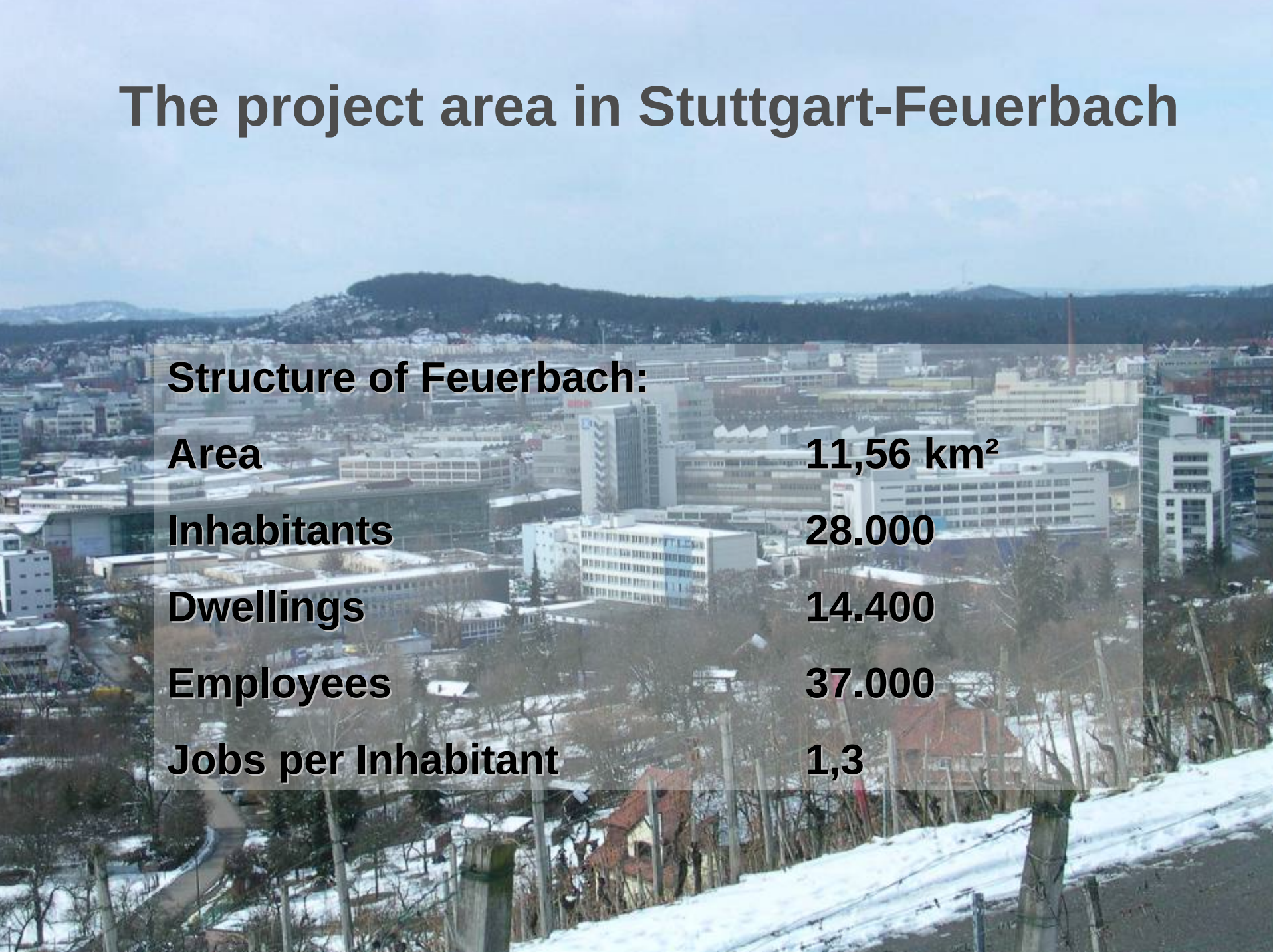
City in between forests and vineyards

Municipal mineral spa Bad Cannstatt

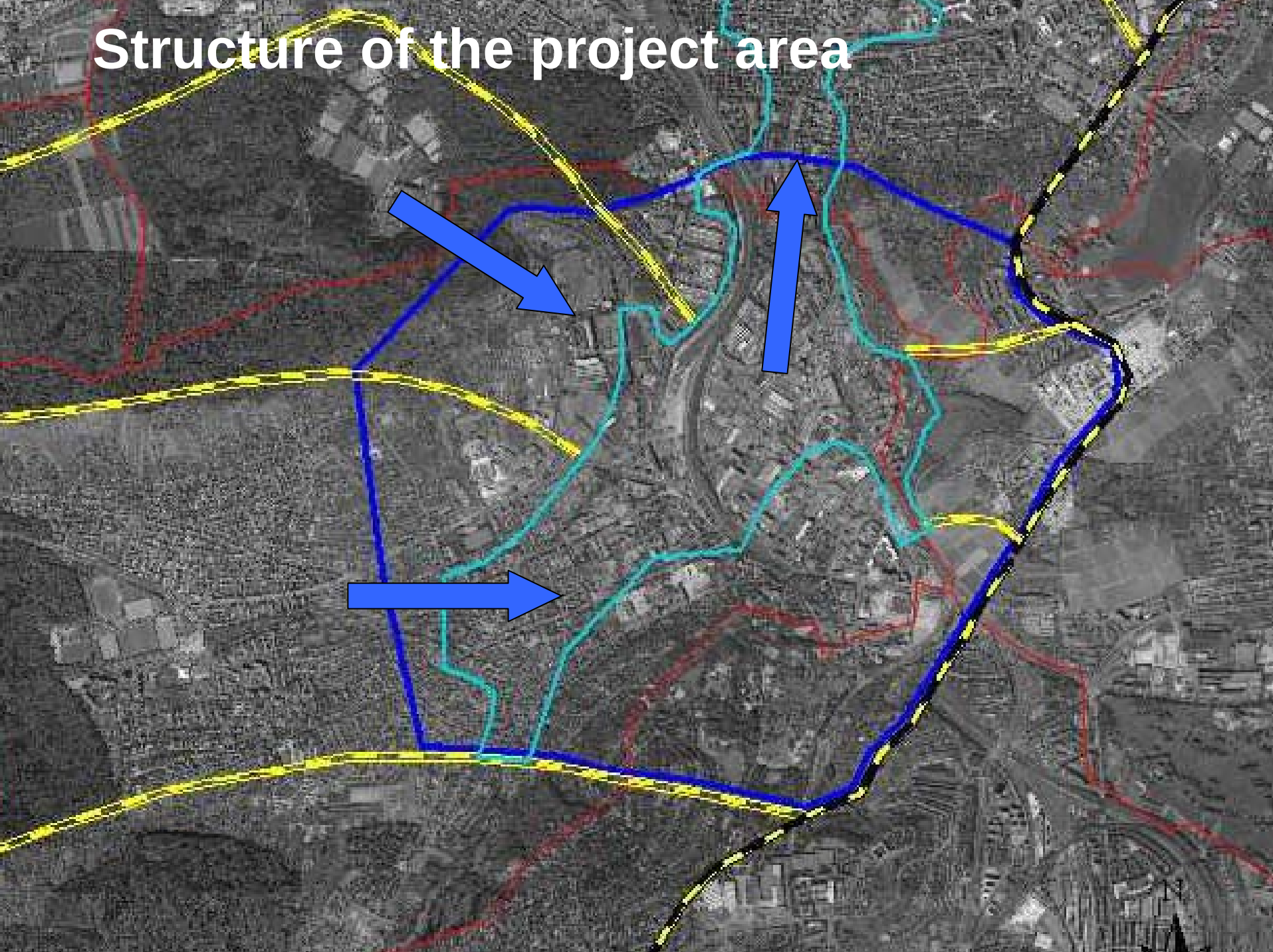

Feuerbach
Area of mineral springs
City centre
Neckar valley

The project area in Stuttgart-Feuerbach



Structure of Feuerbach:	
Area	11,56 km²
Inhabitants	28.000
Dwellings	14.400
Employees	37.000
Jobs per Inhabitant	1,3

Structure of the project area



Initial situation: Complex hydrogeological conditions

Gypsum layer

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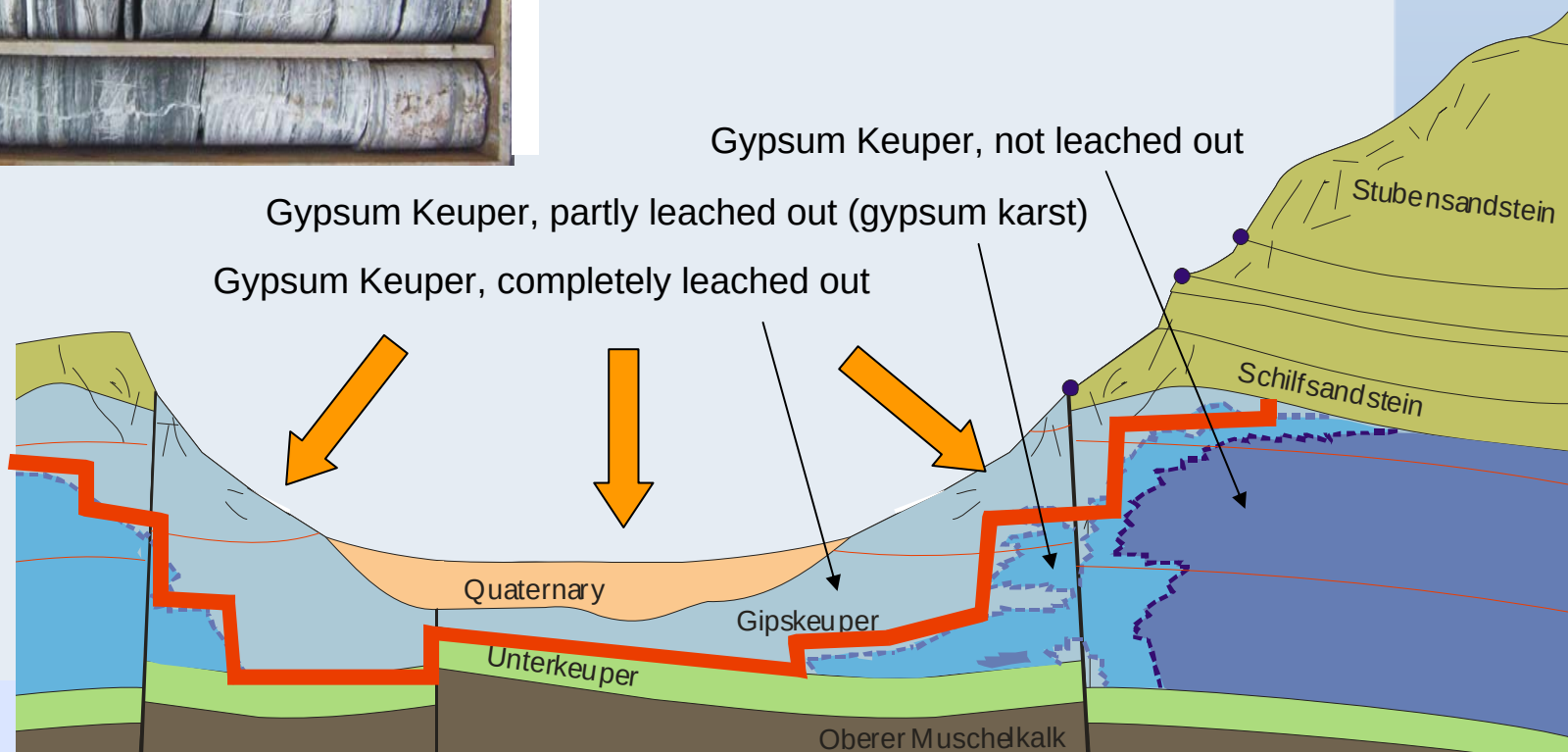
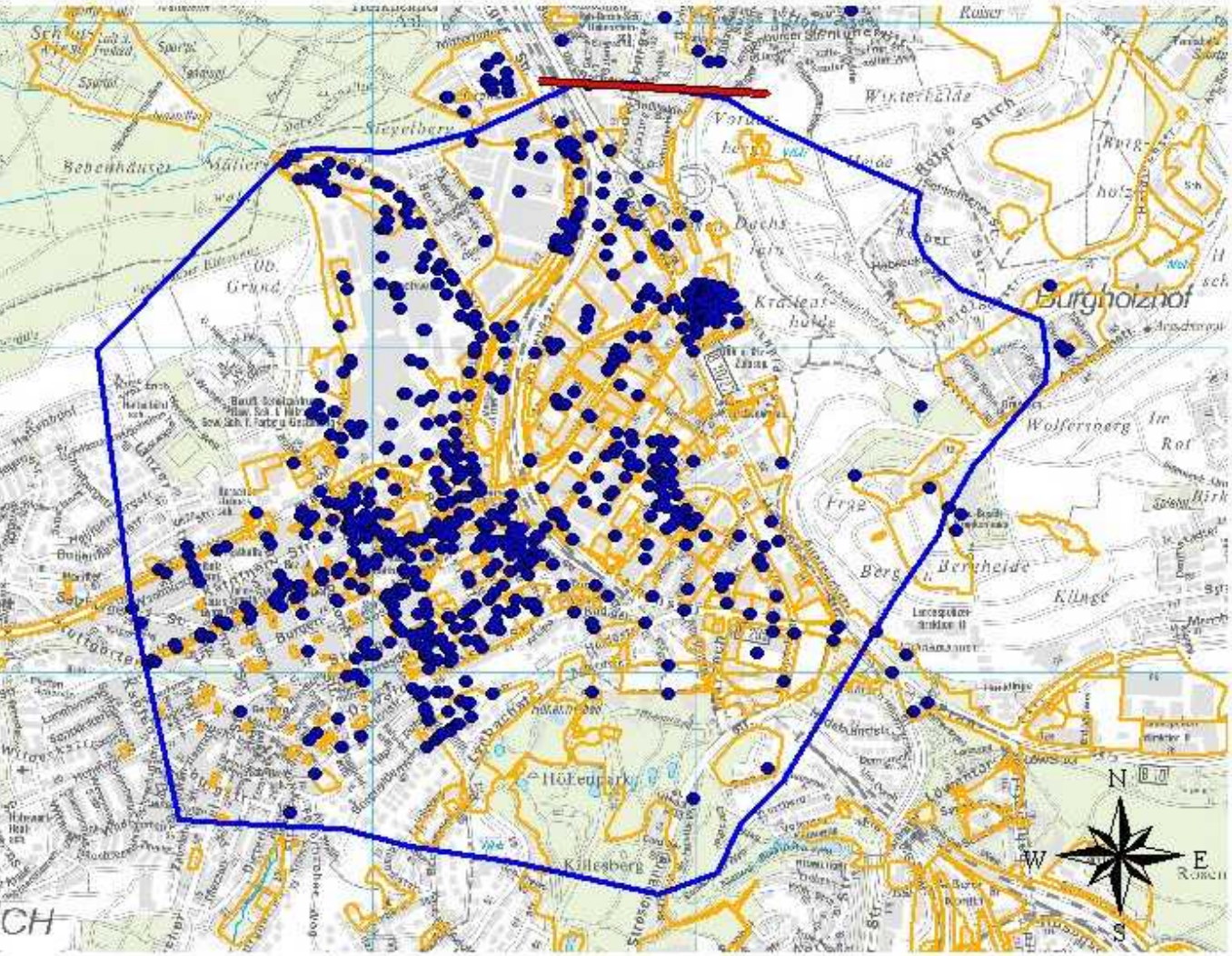


Initial situation:
900 monitoring wells and 200 potentially contaminated sites



groundwater monitoring wells

- groundwater monitoring wells
- project area
- potentially contaminated land
- control plane downstream of project area

status quo: November 2004
data source: BOISS

0 200 400 600 800 Meter

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Characteristics of the project area

- 530 ha project area within the valley of the water course “Feuerbach”
- Densely industrialised, long industrial tradition, global players and small enterprises
- Complex hydrogeological conditions, interaction between 5 different gw-layers
- Many single site investigation activities since 1983, but no overview about gw-quality and no general improvement of the groundwater quality
- Many neighboured sources of soil and gw-pollution with different hazardous substances, especially CHC
- Complex gw-pollution
- Which of about 200 neighboured polluters generates in what matter to the overall gw-pollution?

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Drilling of exploration wells

Drilling of six boreholes for hydro-geological tests in each aquifer down to the bottom of the impermeable gypsum layer

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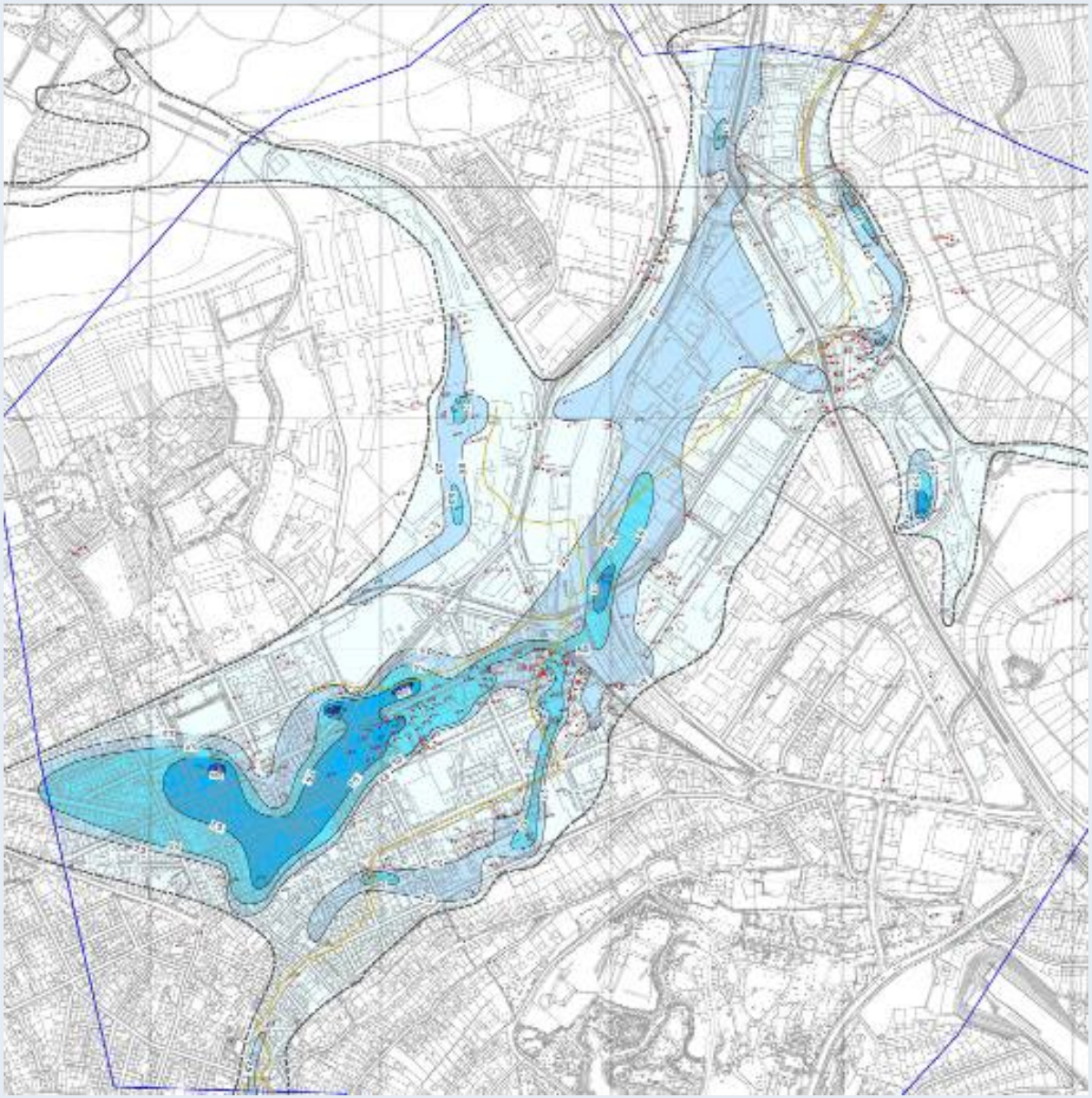
Geometry of the quartanary aquifer



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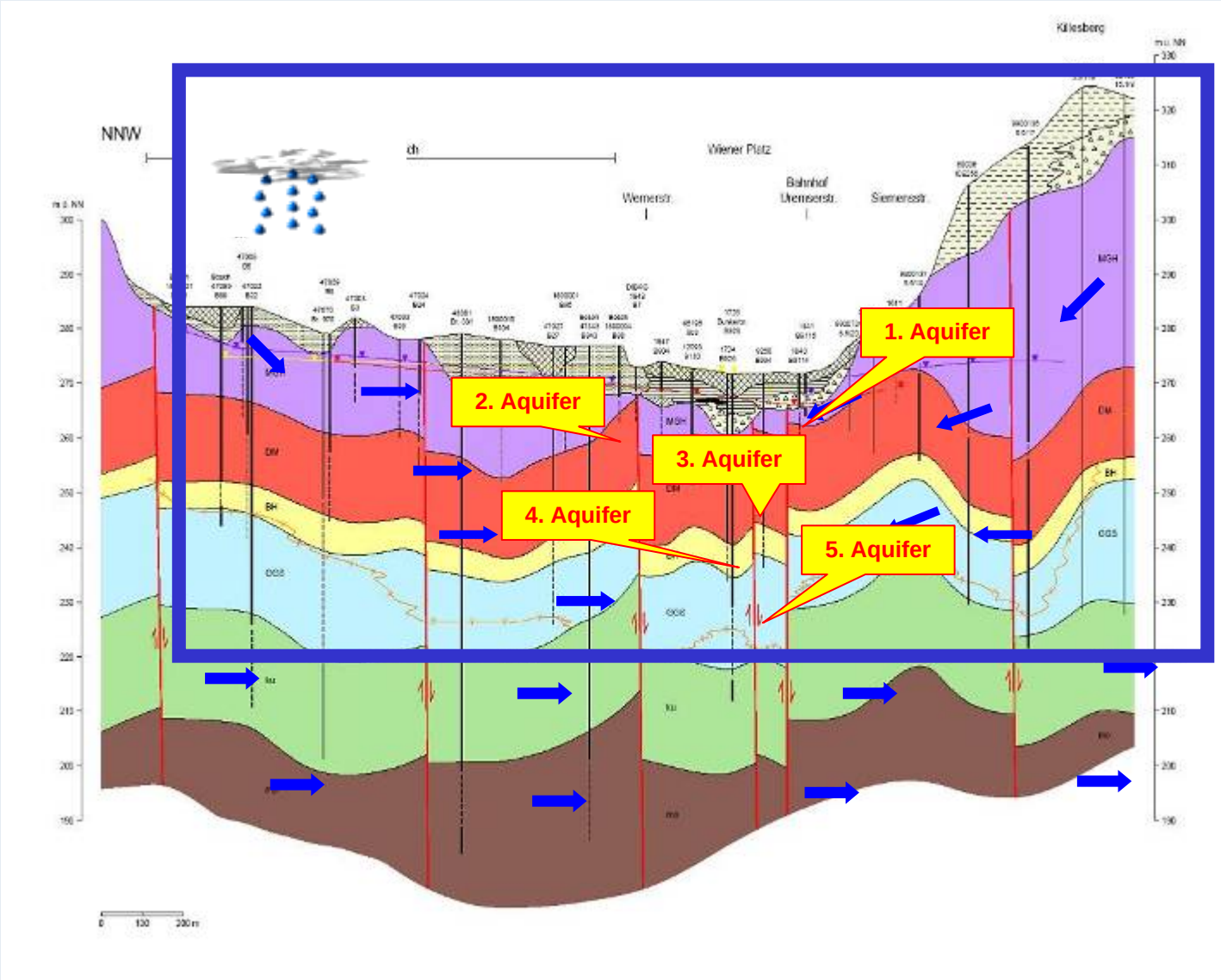
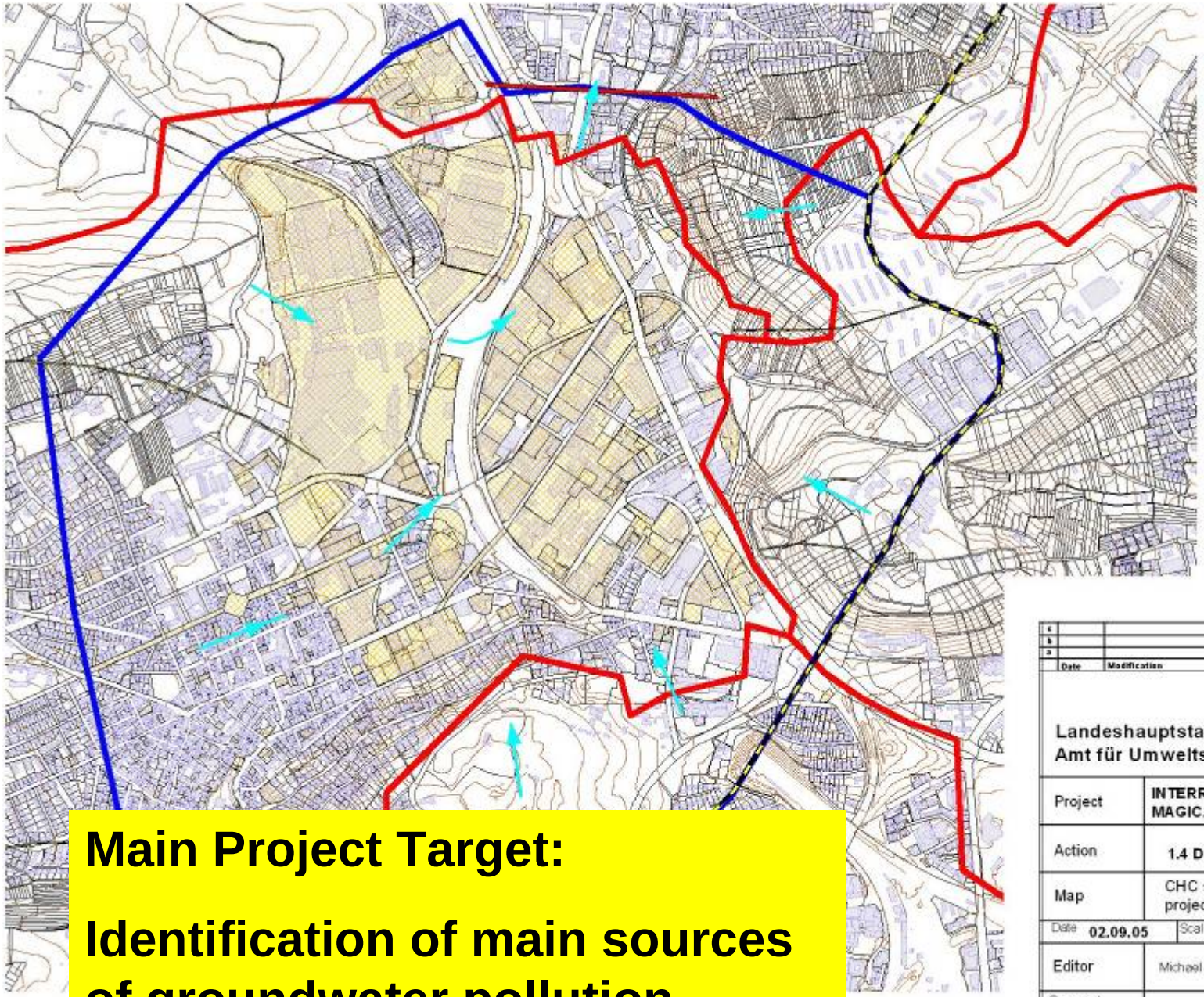
Hydro-geological model





Date	Modification	Sign
c		
b		
a		

Landeshauptstadt STUTTGART
Amt für Umweltschutz

Project	INTERREG III B - CADSES MAGIC, Project Code 5C028
Action	1.4 Data collection
Map	CHC sites in the project area of MAGIC
Date 02.09.05	Scale / Map No. 1.2
Editor	Michael Schweiker
Comment	

Main Project Target:

Identification of main sources of groundwater pollution

MAGIC-Project preparation and implementation -

Integral groundwater investigation and backtracking

- 34 Immission pumping tests (IPTs) along 4 control planes
- Analytical and numerical modelling of gw-flow, migration and distribution of pollutants in the gw
- Calculation of pollutant transport from control planes back to the sources by a numerical transport-model

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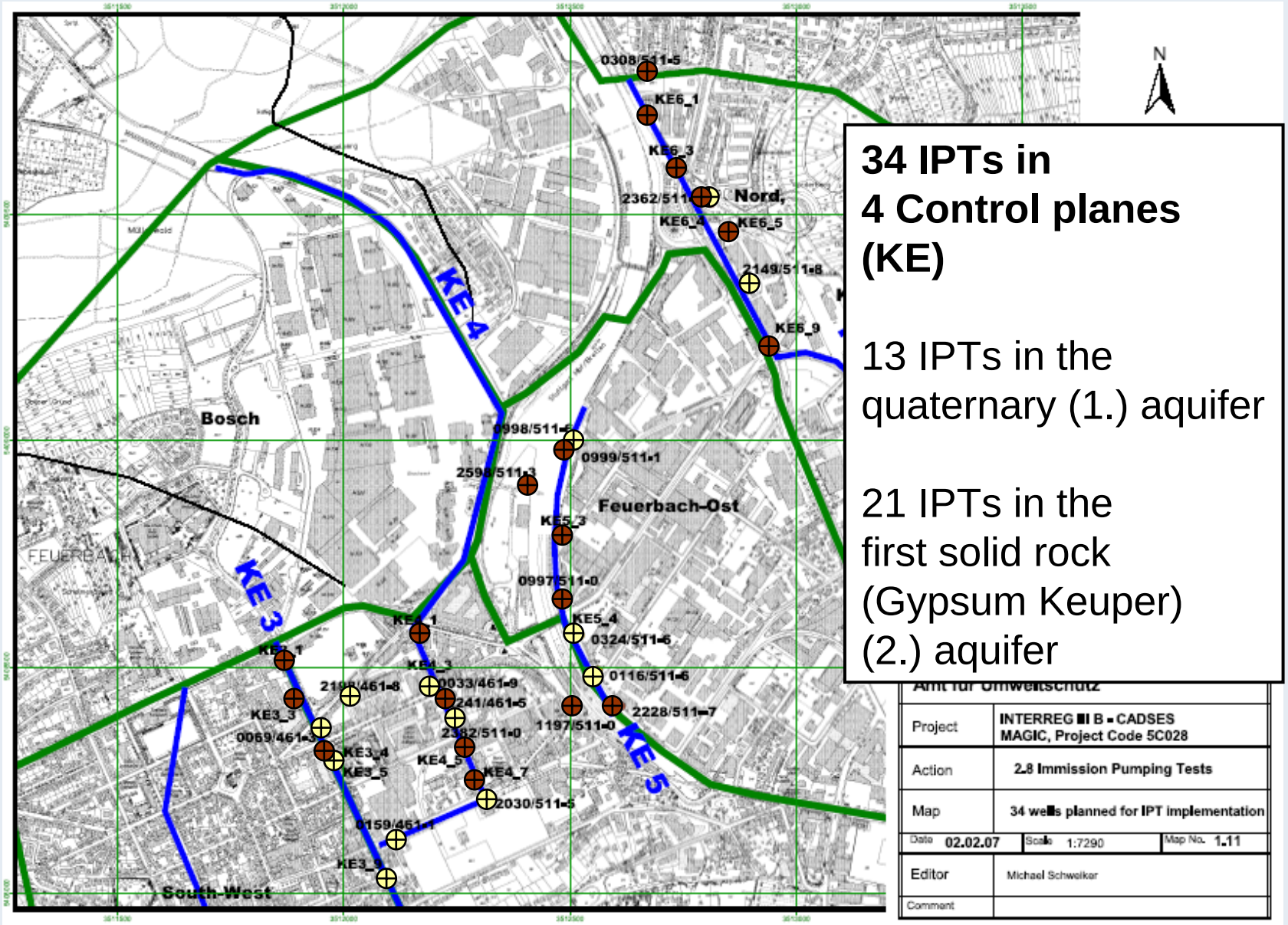
Planning and implementation of IPTs



34 IPTs in
4 Control planes
(KE)

13 IPTs in the quaternary (1.) aquifer

21 IPTs in the first solid rock (Gypsum Keuper) (2.) aquifer

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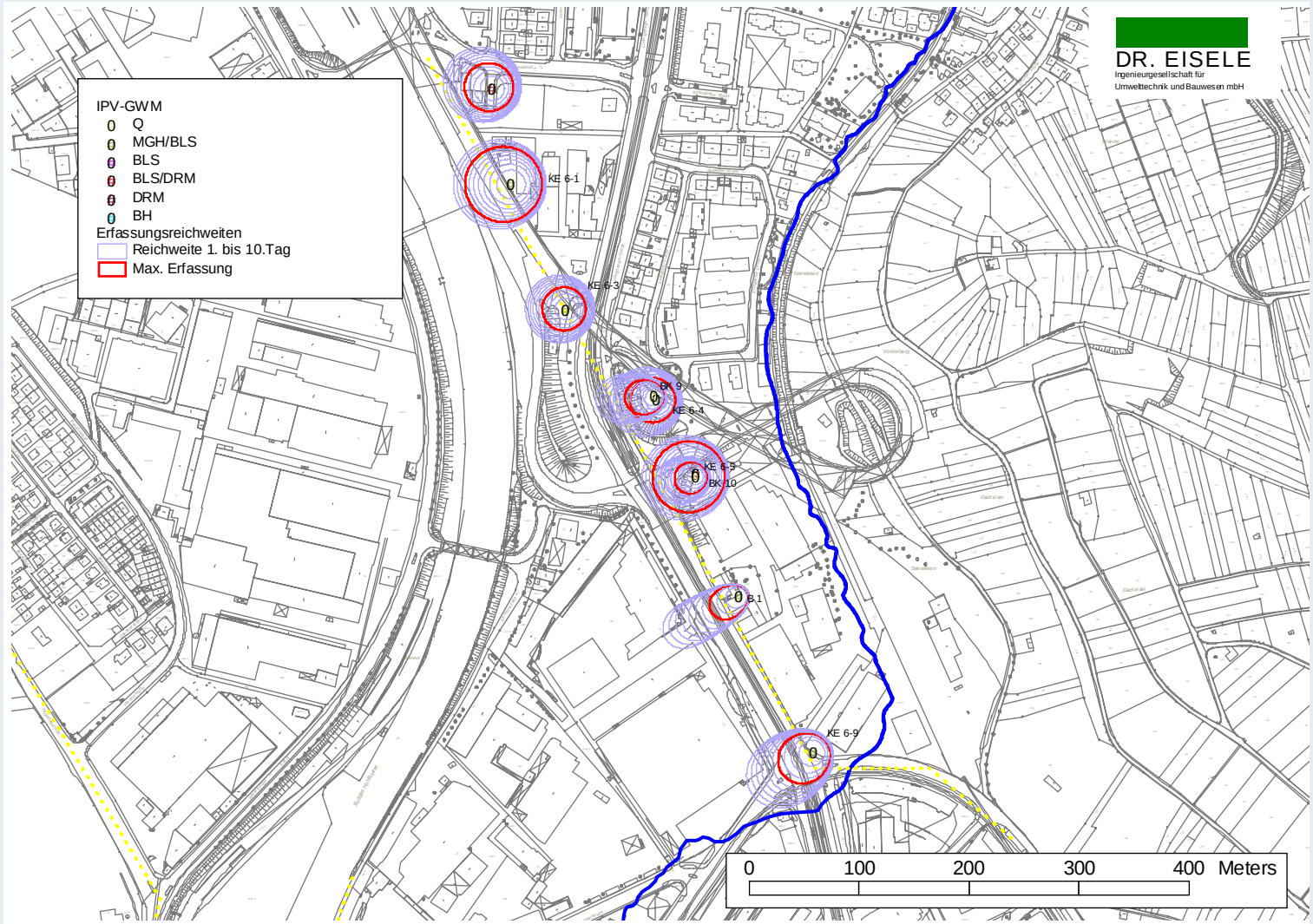
Implementation of Immission Pumping Tests (IPT)

- 34 IPT between April and July 2007
- Duration of each IPT: 66 to 167 hours
- Pumping rates: 0,02 to 3,5 l/s
- Installation of the pump near the bottom of the well
- Sampling before measuring test parameters
- Digitised recording of test parameters
- Materials:
  - Pumps: stainless steal
  - Pump for alternative sampling (~0,1 l/s): PE
  - Test box: PE, PVC
  - Tubes: PVC
  - Sampling tube: Teflon

Analytical evaluation of IPTs



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Analytische Auswertung von Immissionspumpversuchen

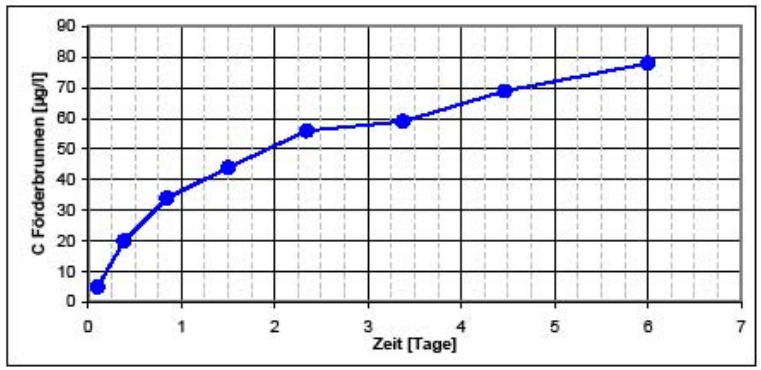
DR. EISELE

Ingenieurgesellschaft für Umwelttechnik und Bauwesen mbH

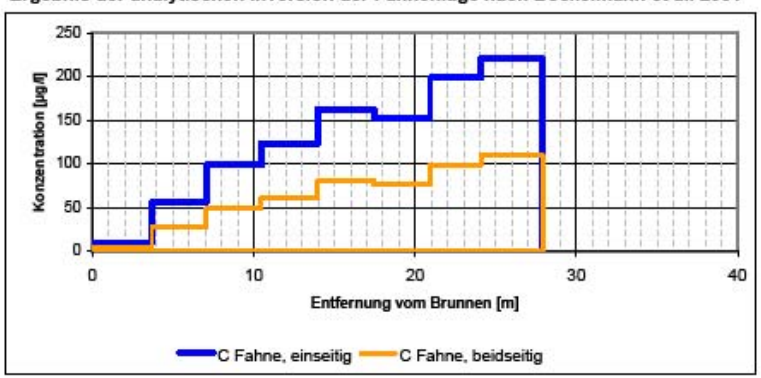
Projekt- und Versuchsdaten

Projekt	MAGIC IPV
Projektnummer	IUB 07-ST-0017
Brunnen	KE 6-5 7117/511-9
Schadstoffparameter	LHKW (Summe)
Einheit:	µg/l
Pumprate [l/s]:	0,85
Aquifermächtigkeit [m]:	12
durchflusswirksame Porosität [-]	0,015
Schwellenwert [µg/l]	0
Beginn Pumpversuch [Datum Uhrzeit]	16.04.2007 10:35

Konzentrationsentwicklung über Pumpzeit



Ergebnis der analytischen Inversion der Fahnenlage nach Bockelmann et al. 2001



Analytische Auswertung von Immissionspumpversuchen

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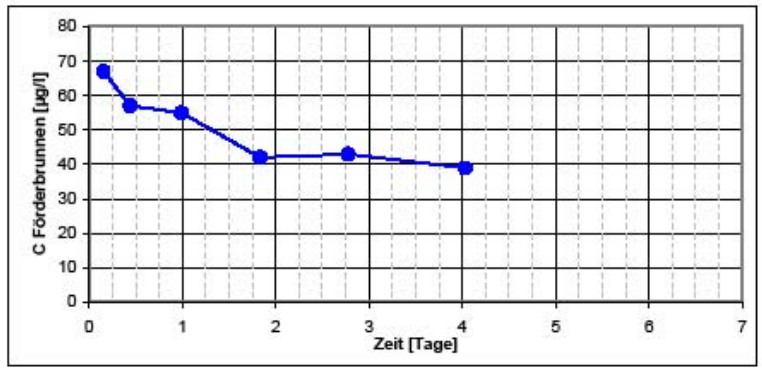
DR. EISELE

Ingenieurgesellschaft für Umwelttechnik und Bauwesen mbH

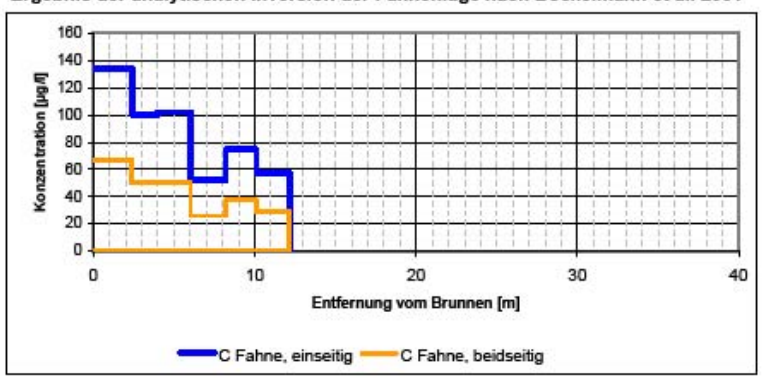
Projekt- und Versuchsdaten

Projekt	MAGIC IPV
Projektnummer	IUB 07-ST-0017
Brunnen	B 955 0033/461-9
Schadstoffparameter	LHKW (Summe)
Einheit:	µg/l
Pumprate [l/s]:	0,2
Aquifermächtigkeit [m]:	3
durchflusswirksame Porosität [-]	0,05
Schwellenwert [µg/l]	0
Beginn Pumpversuch [Datum Uhrzeit]	02.07.2007 12:17

Konzentrationsentwicklung über Pumpzeit



Ergebnis der analytischen Inversion der Fahnenlage nach Bockelmann et al. 2001



First results of MAGIC approach implementation

for the Stuttgart project area in 5 aquifers

- Distribution of transmissivity
- Analytical and numerical model of pollution distribution and migration in the 5 aquifers
- Calculated CHC-distribution in the 5 aquifers
- Synopsis of plumes and sources

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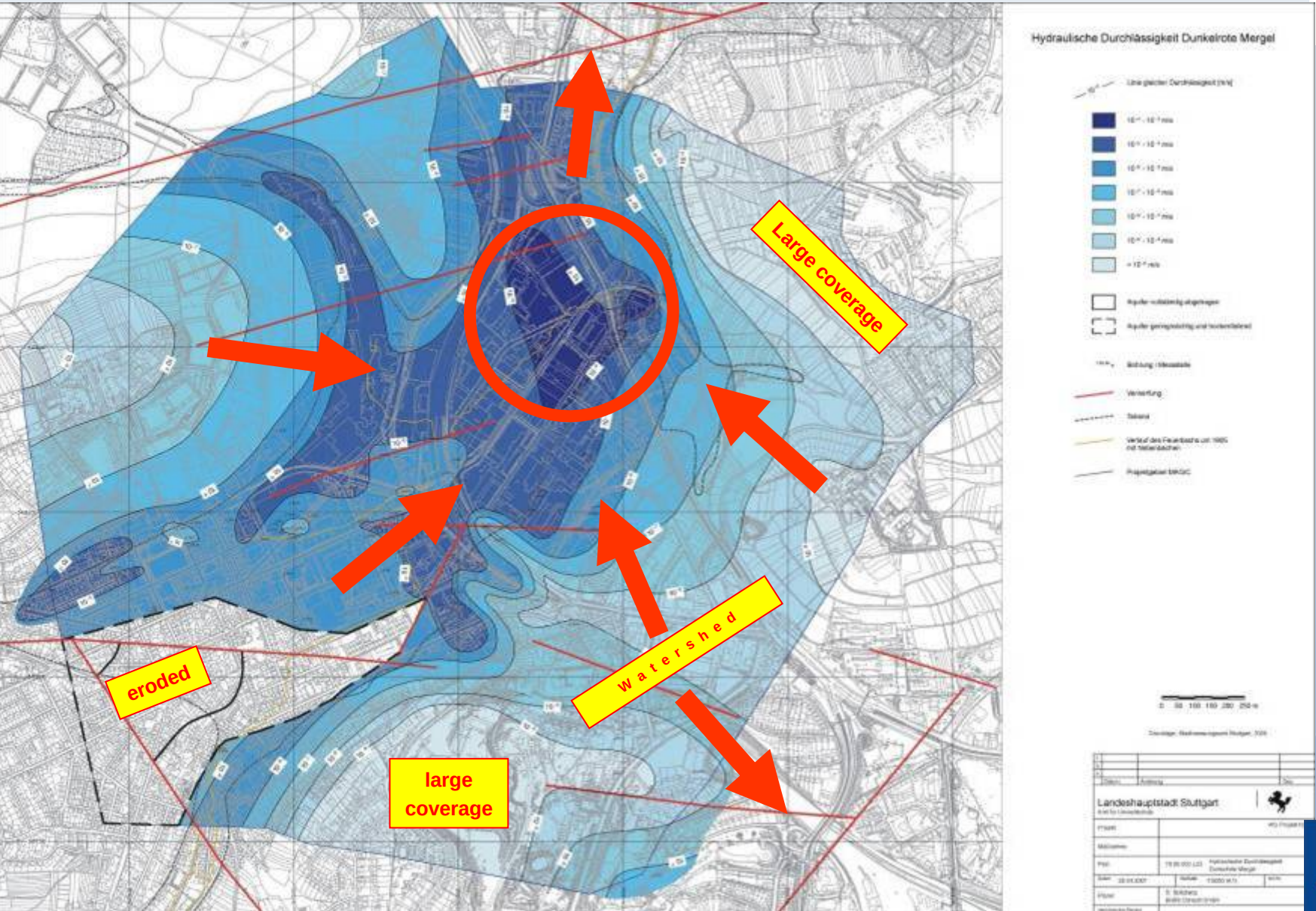
The distribution of transmissivity
(exemplary in the third of five aquifers)



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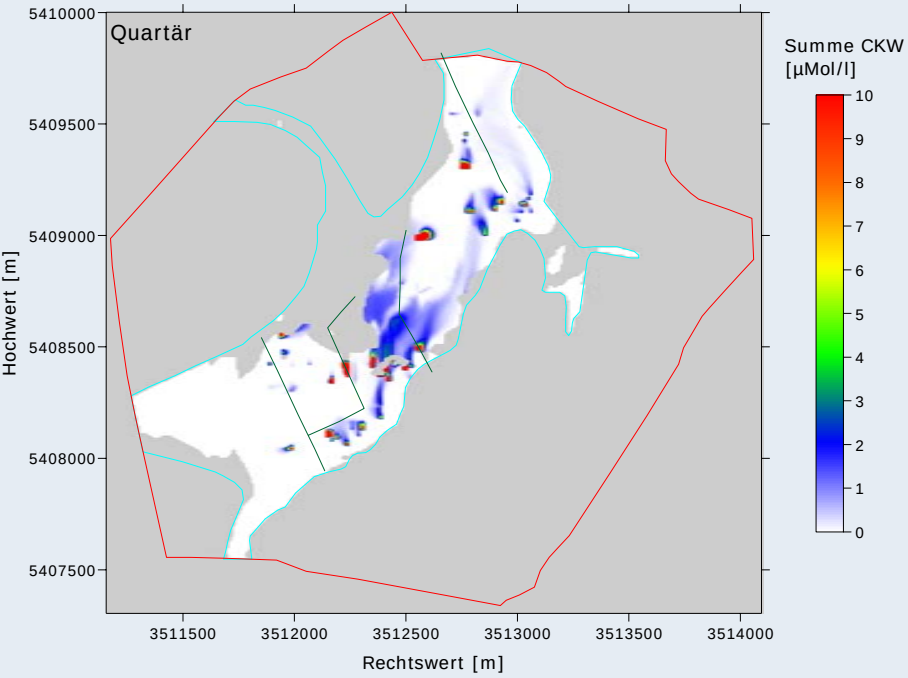
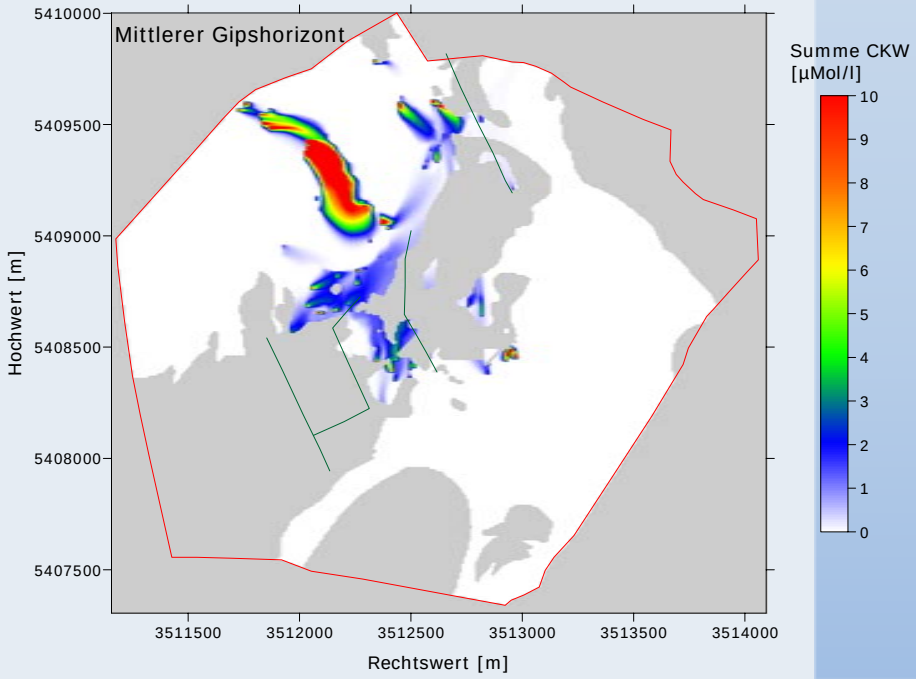
Calculated distribution of CHC concentration

Quaternary sediments
(1. Aquifer)



Triassic rock
(Middle gypsum Keuper)
(2. Aquifer)



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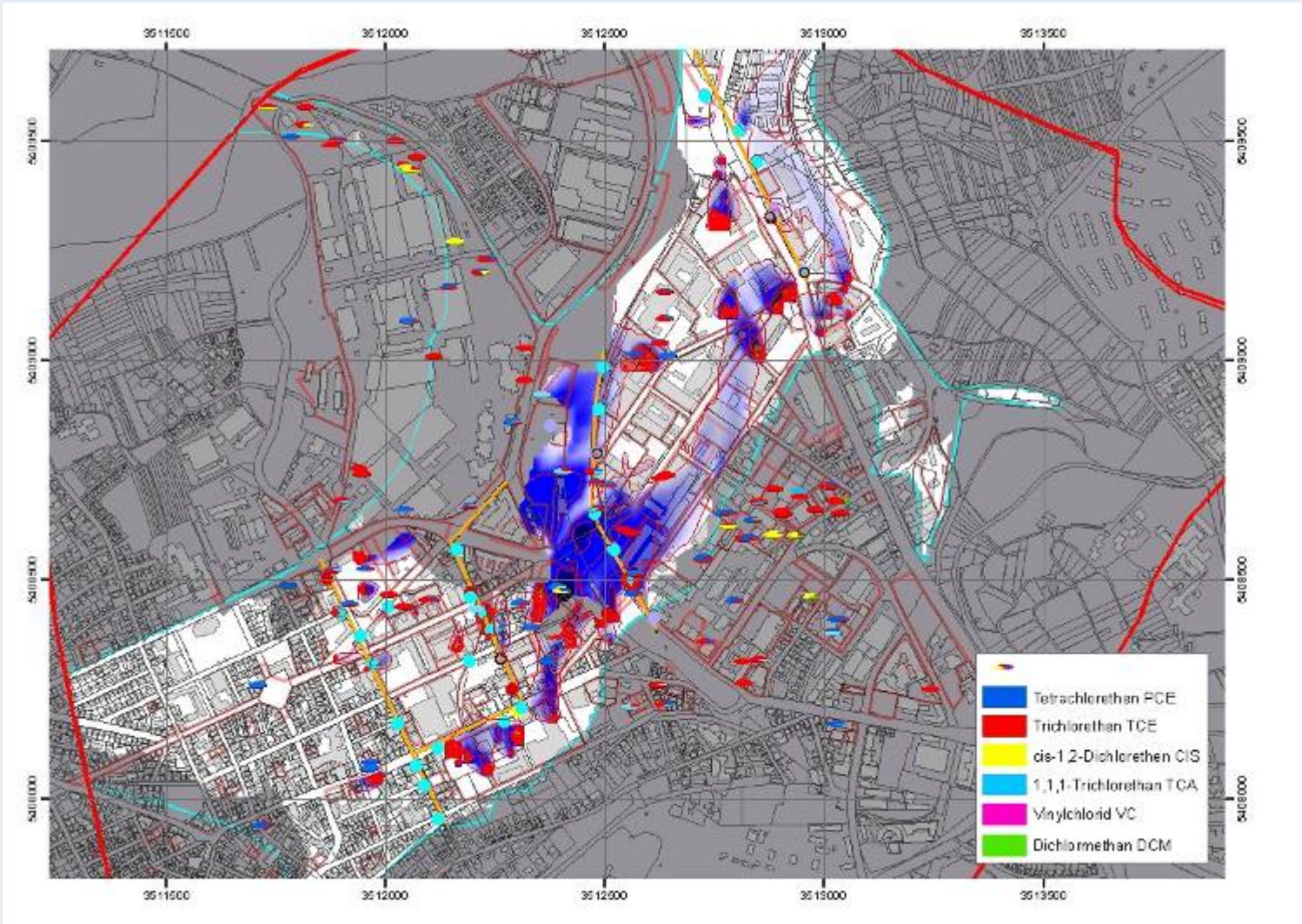
Synopsis of Sources and Plumes



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Final steps in Stuttgart

Combination of plumes and sources

- Source and plume ➔ Remediation
- Plume but no source ➔ Search the source
- Source but no plume ➔ Source not relevant

Prioritization of contamination

- Concentration
- Load
- Plume length

Public presentation of all project results March 2008 in Katowice

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Thank you

for your attention!

Contact:
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www.magic-cadses.com