

Sustainable groundwater management on the military training area Altmark

Groundwater Monitoring on behalf of the

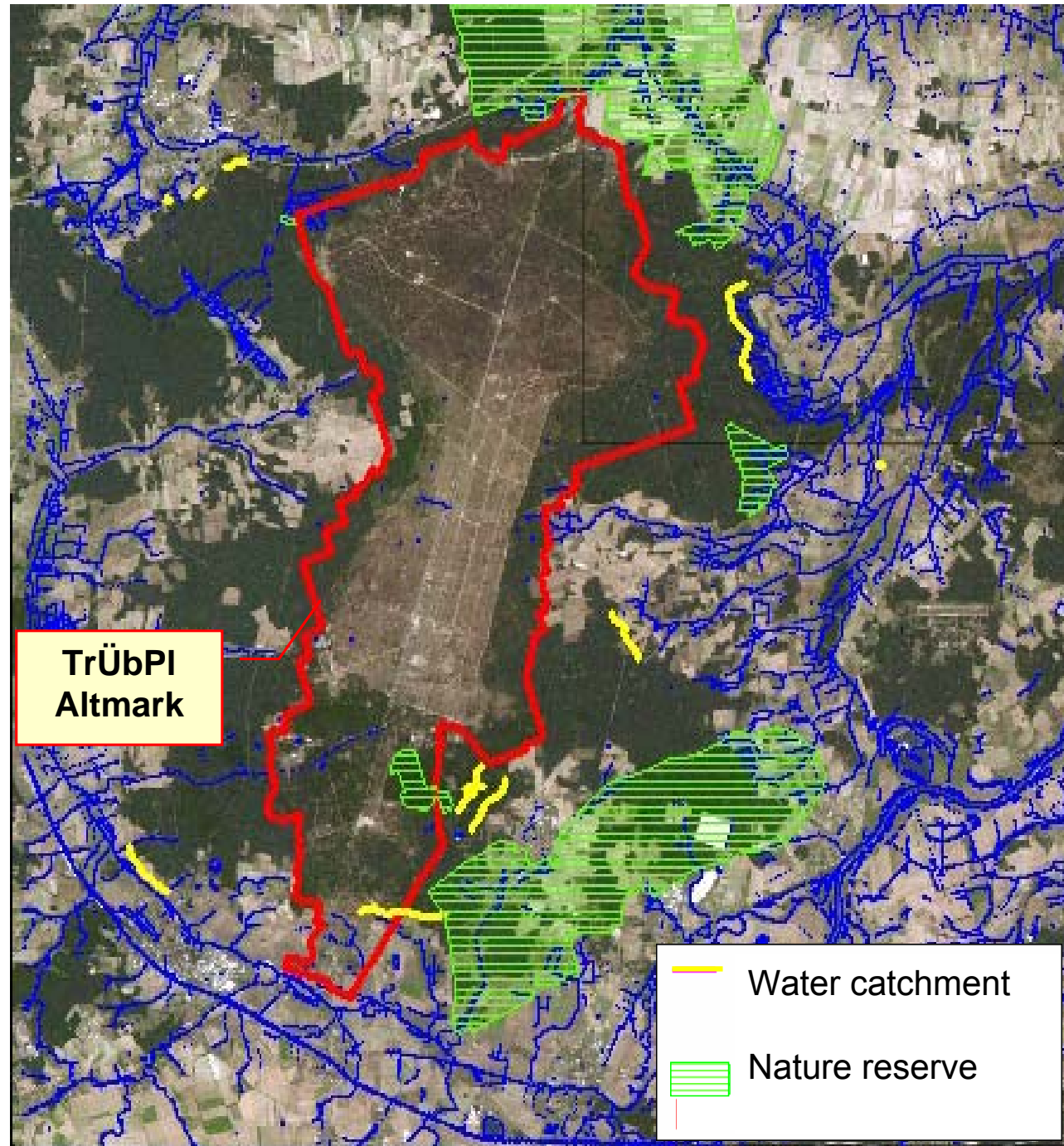
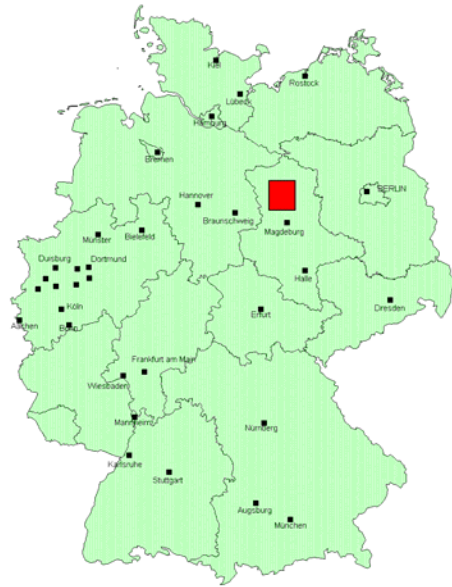


C. Ertl
U. Maiwald

Contents

- ④ Overview of the investigation area
- ④ Different utilisation claims
- ④ Previous studies of the BGR
- ④ Structure of the Groundwater Monitoring
- ④ Selected results

Overview of the investigation area



Different utilisation claims



Many decades of military use

1934-36 Artillery range Hillersleben

1945 American Forces

1945-94 Soviet Troops

Since 1994 German Federal Armed Forces



Nature Protection



Multiplicity of protected plants, birds and biotopes

Drinking Water Supply



4 waterworks

on the verge of the military training area catchments extend into the training area

Project phases of the BGR

- 1992 BMVg indents the BGR for hydrogeological investigations
- 1993/1995 Drilling of 176 observation wells at 56 locations
(measurement of water levels, sampling, pumping tests)
surface geophysics
- 1993 – 1998 5 measurements at 650 observation wells
Analysis
- Since 1998 Long-term Groundwater Monitoring
1. Campaign 1998/1999
 2. Campaign 2001
 3. Campaign 2003
 4. Campaign 2005

Structure of the Groundwater Monitoring

Hydrogeological studies

Geology

- monitoring wells
- series
- groundwater storeys
- properties

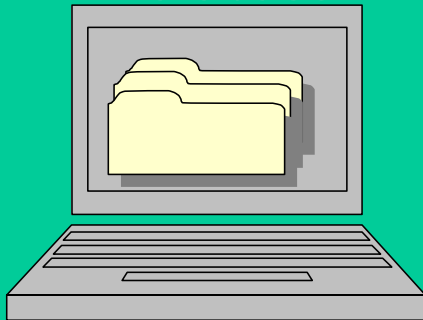
Groundwater Dynamic

- water levels
- hydrodynamics
- groundwater management
- storage

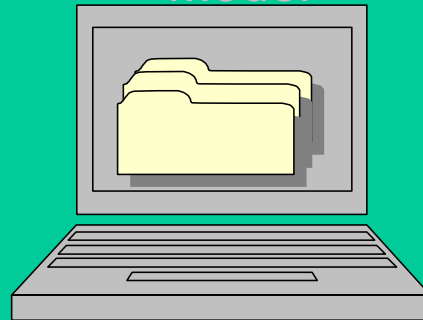
Groundwater Quality

- previous utilisation / contaminated sites
- sampling
- analysis
- risk potential

Hydrogeological Database



Numerical Model



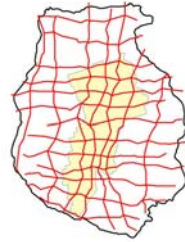
Reports



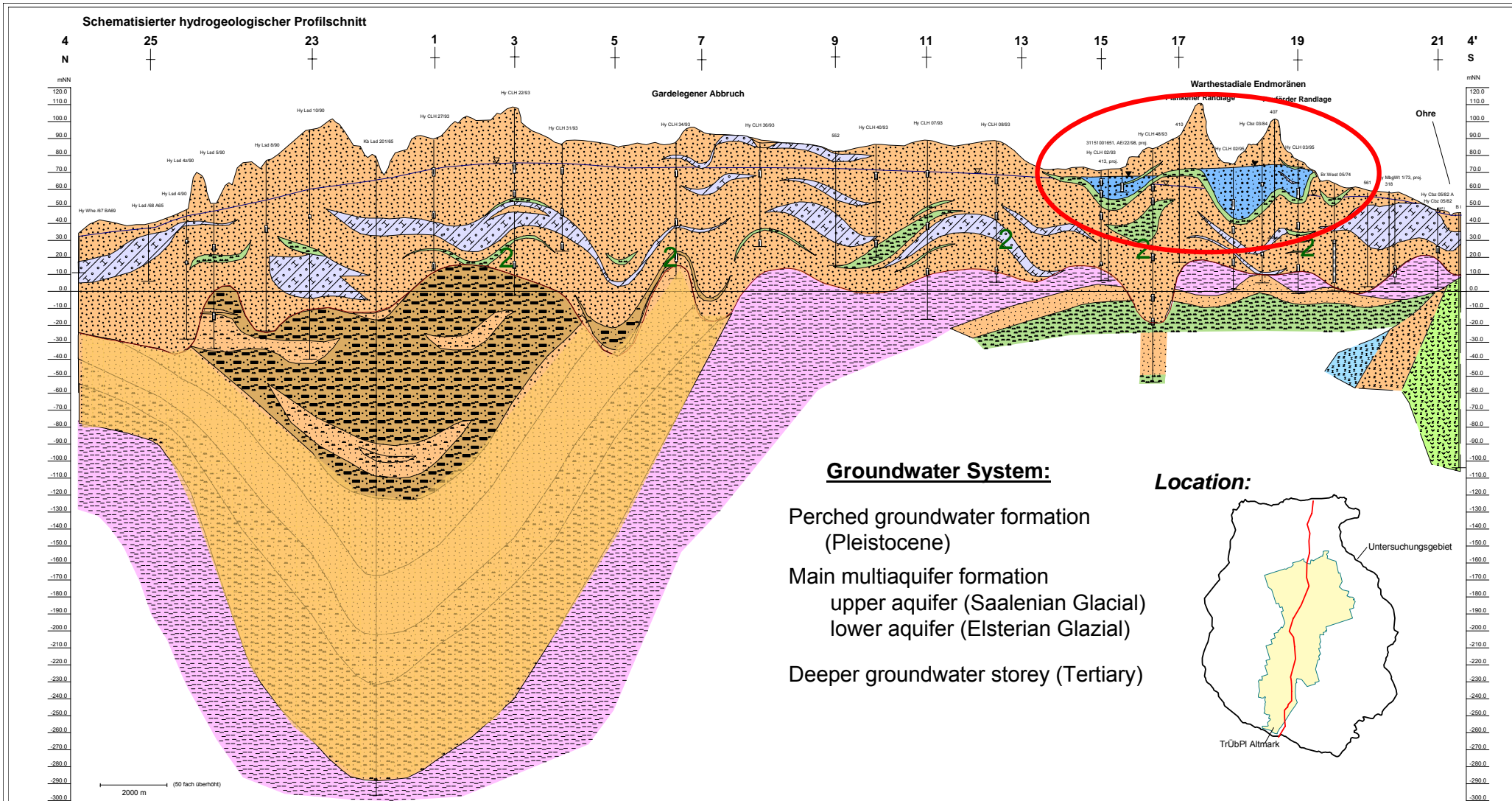
Information

Advice
of the
BMVg

Geology



20 Hydrogeological Cross-Sections 3 Multiaquifer formations

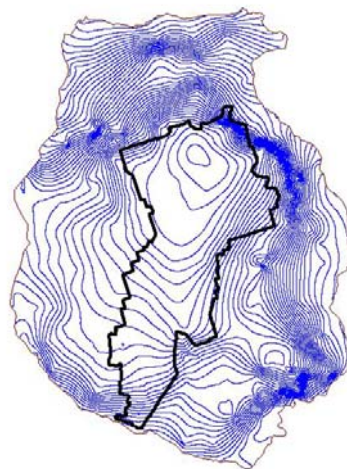
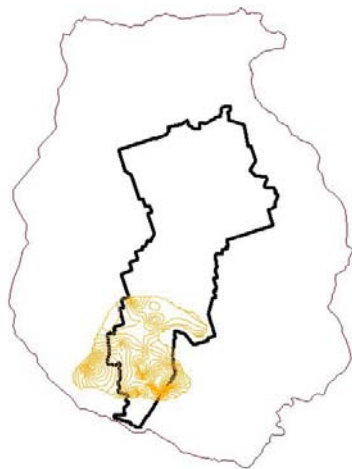


Groundwater dynamic

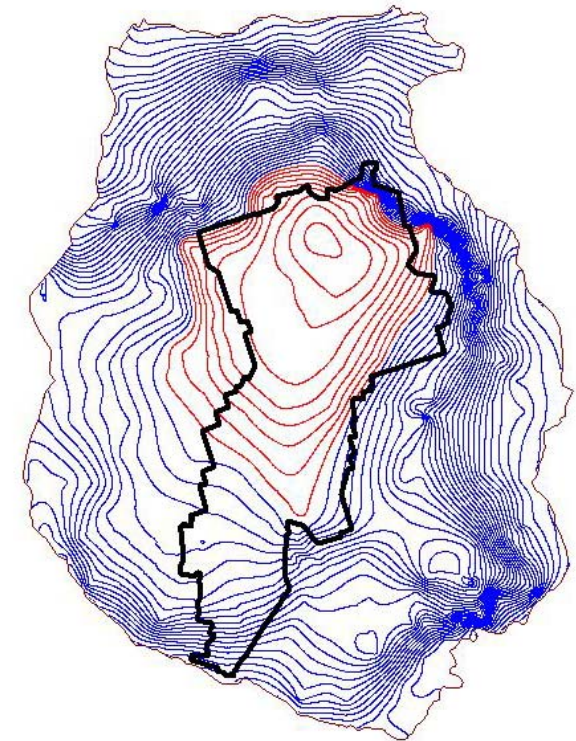
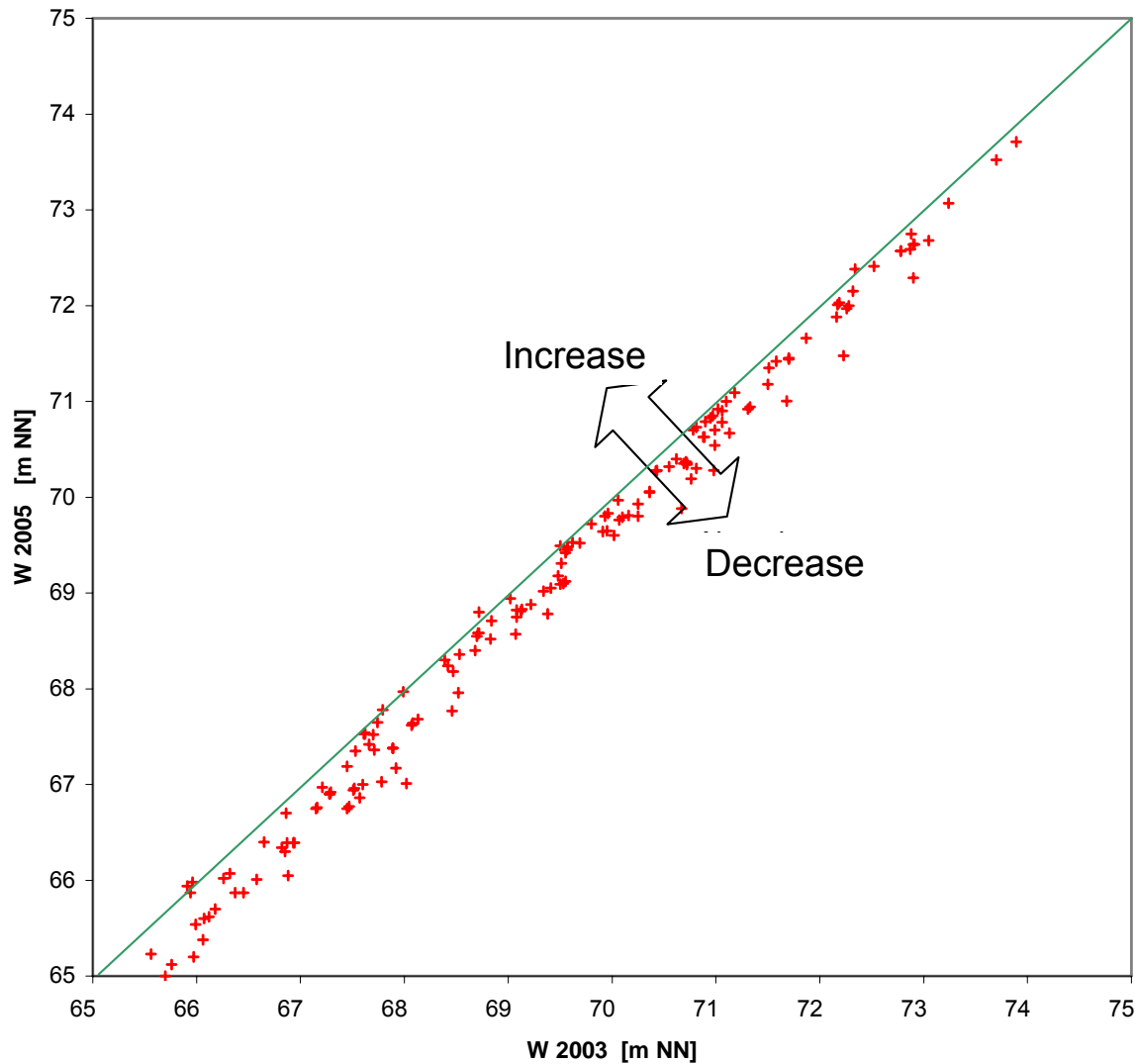
- Construction of water table contours
- Comparison of the different water tables
- Rate of recharge
- Development of the hydrographs

Water Table Contours

- Perched groundwater formation
- Main multiaquifer formation (upper and lower aquifer)
- Deeper groundwater storey

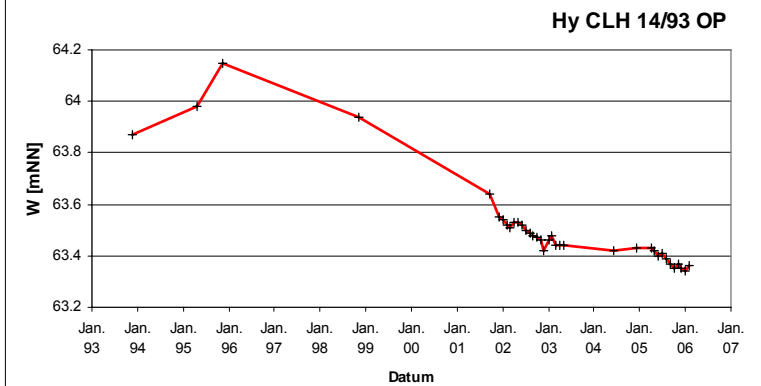
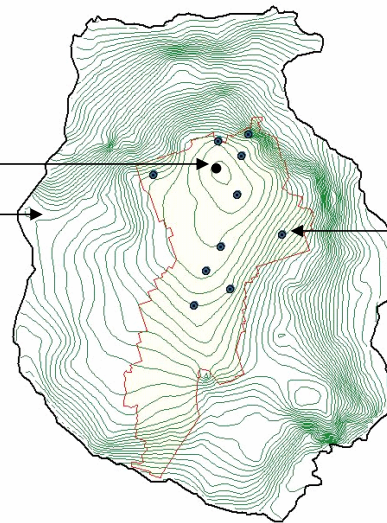
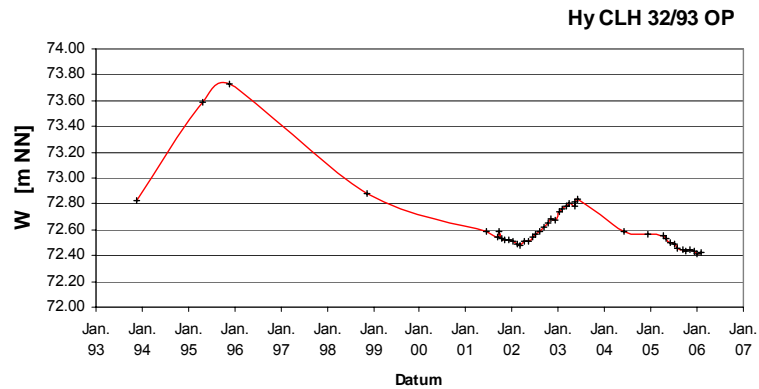
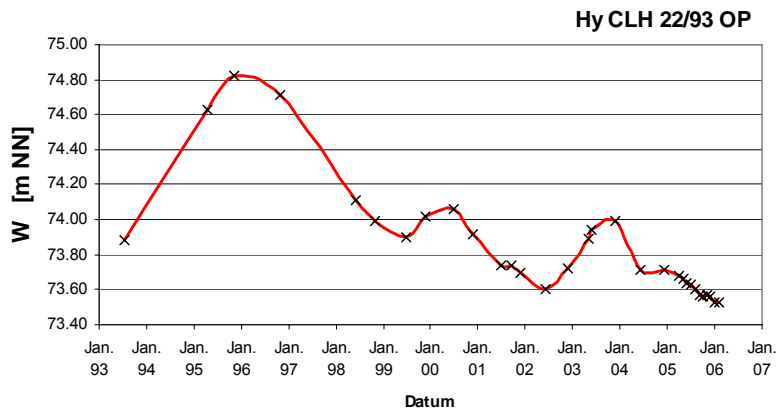


Comparison of the water levels of the 3rd und 4th campaign



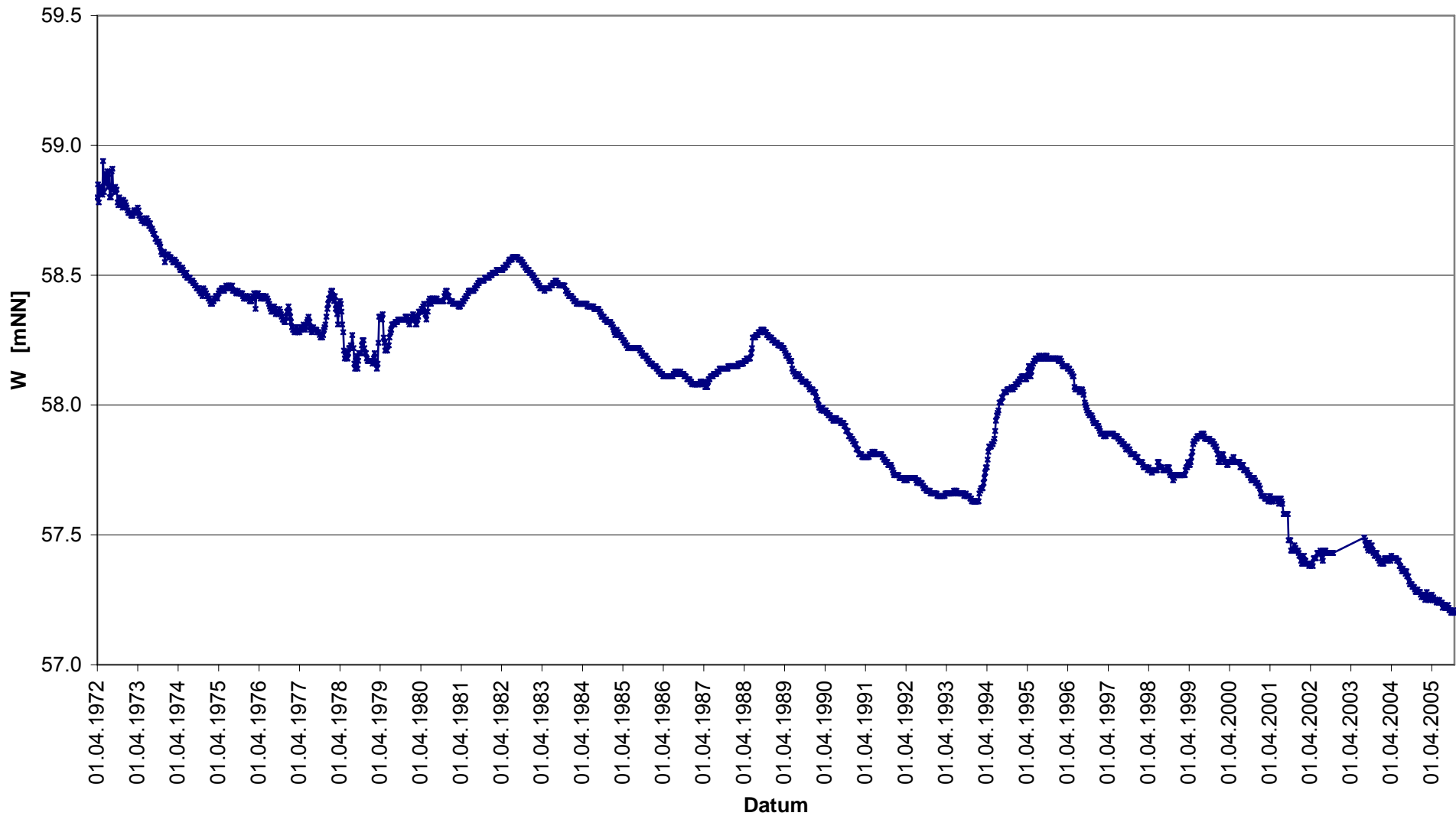
$$\Delta_m = -34 \text{ cm}$$

Annual Hydrographs

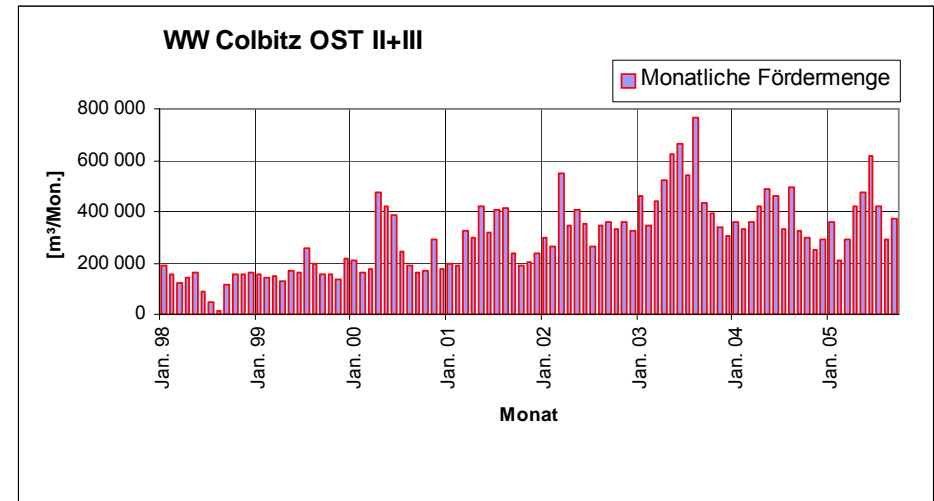
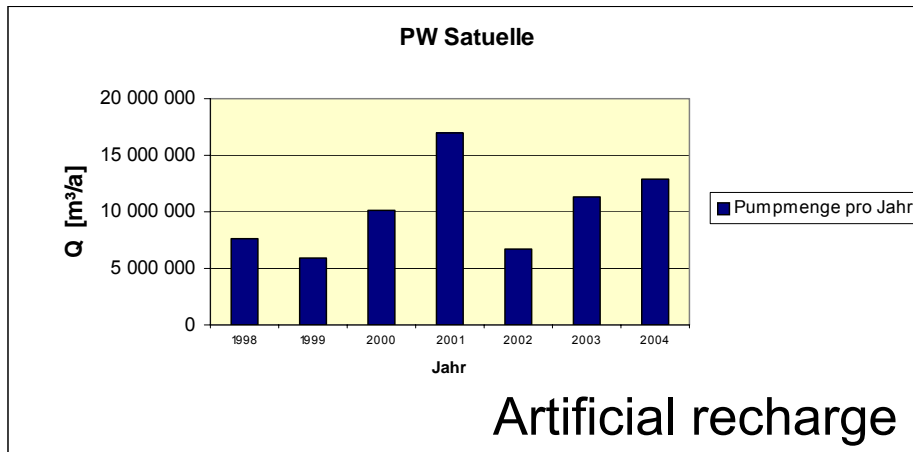
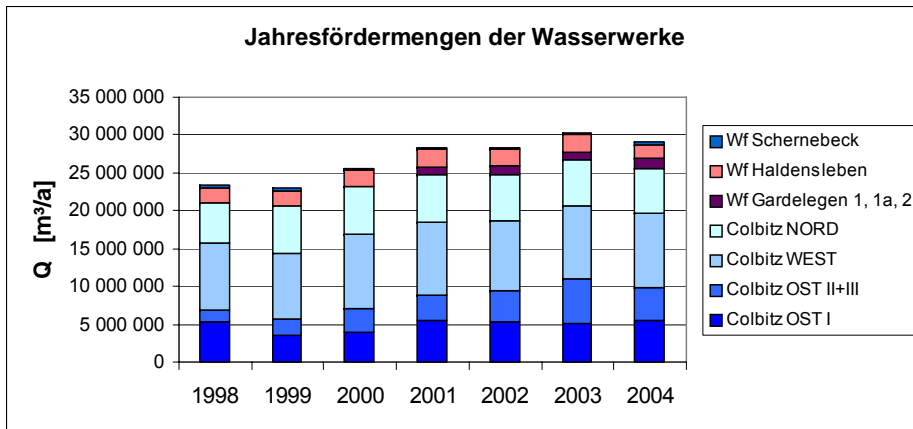


Annual Hydrographs

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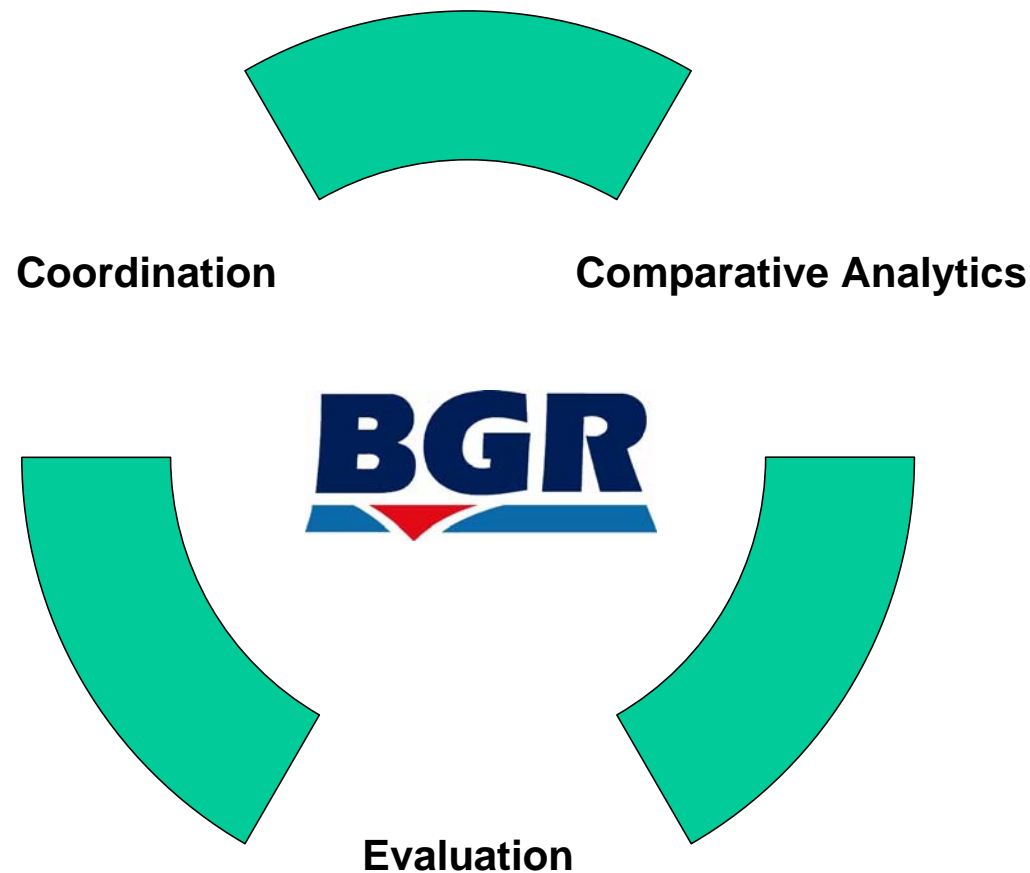


Groundwater Withdrawal of the Waterworks



Groundwater Quality

BGR tasks during sampling campaigns of the long-term groundwater monitoring



Groundwater Quality

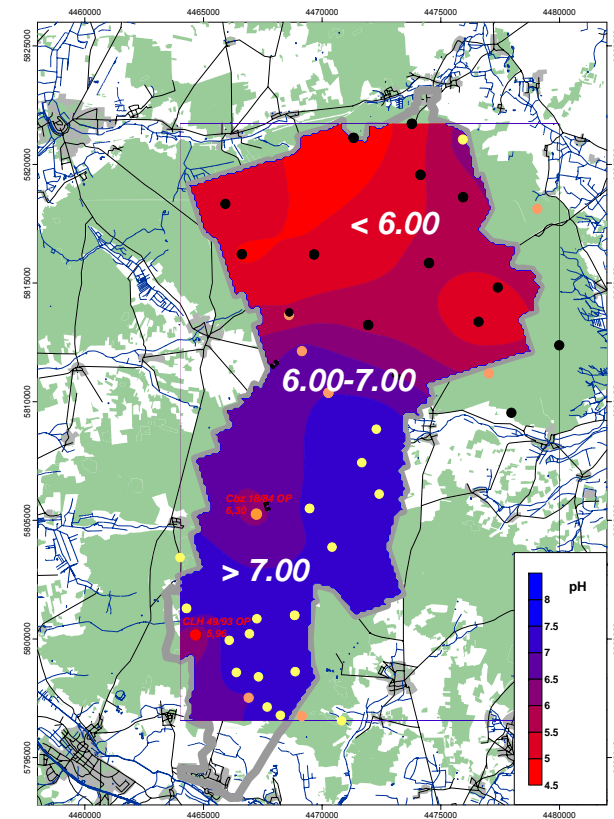
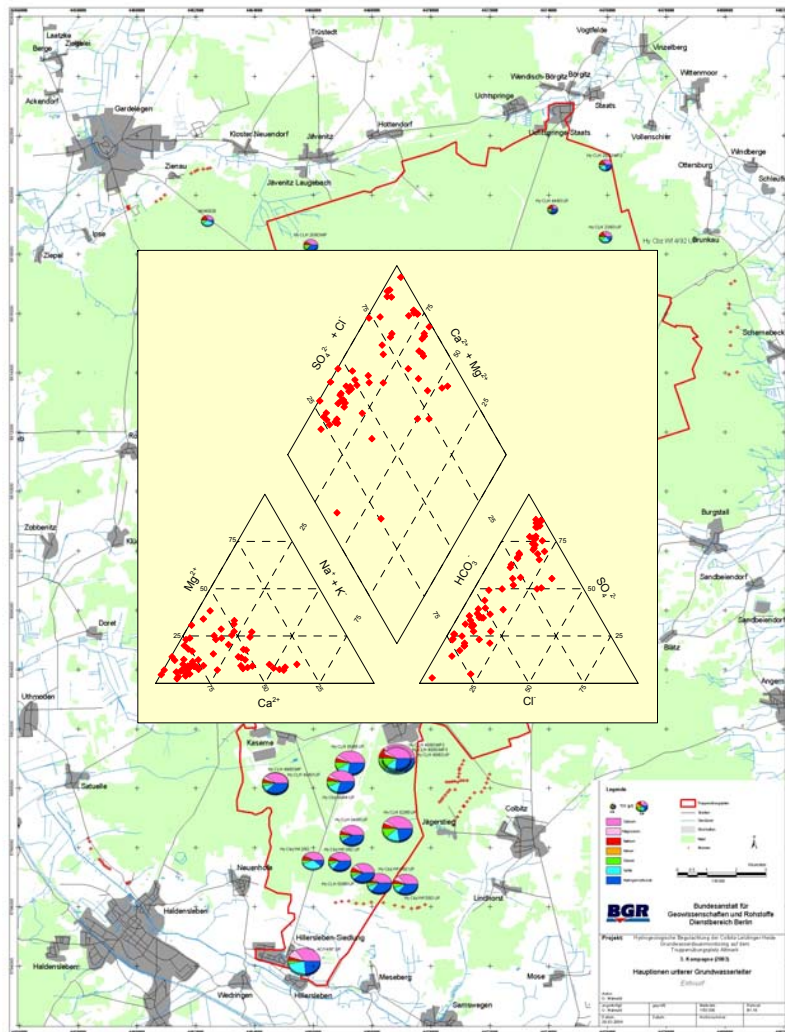
Analysed Parameters:

- geogenetic base load / natural background:
 - main components
- substances with residual origin:
 - nitrogenous ions, sulphate, potassium, boron, AOX
 - specific heavy metals (Cu, Ni, Zn, (As))
- specific organic substances:
 - petroleum-derived hydrocarbons
 - polychlorinated biphenyls
 - polycyclic aromatic hydrocarbons
 - volatile halogenated hydrocarbons
 - monoaromatic hydrocarbons
 - specific explosives

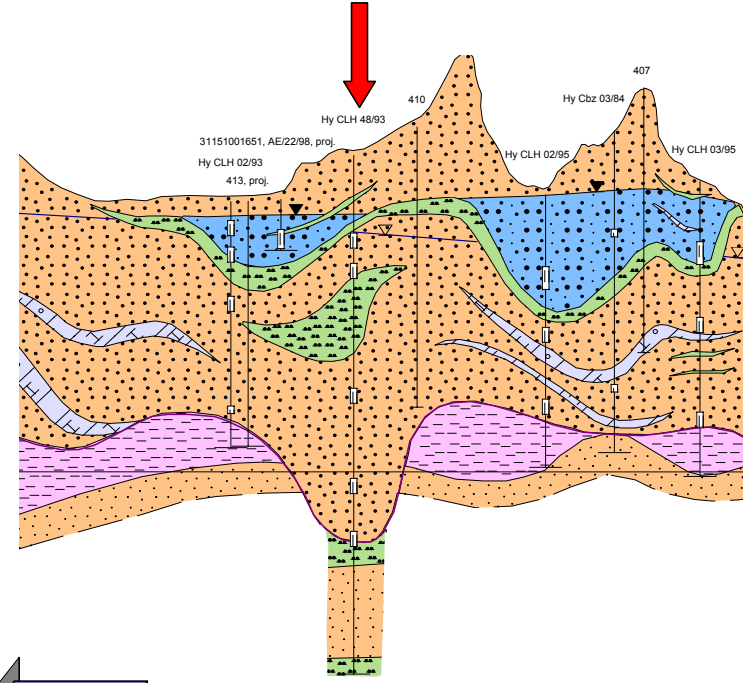
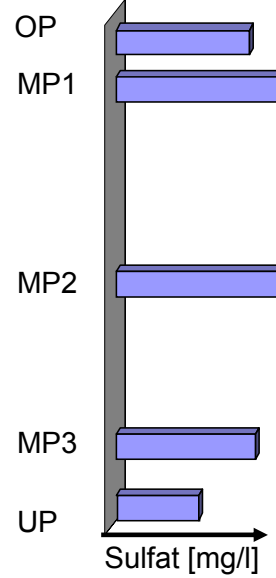
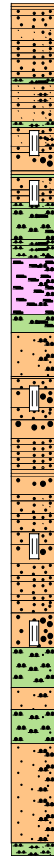
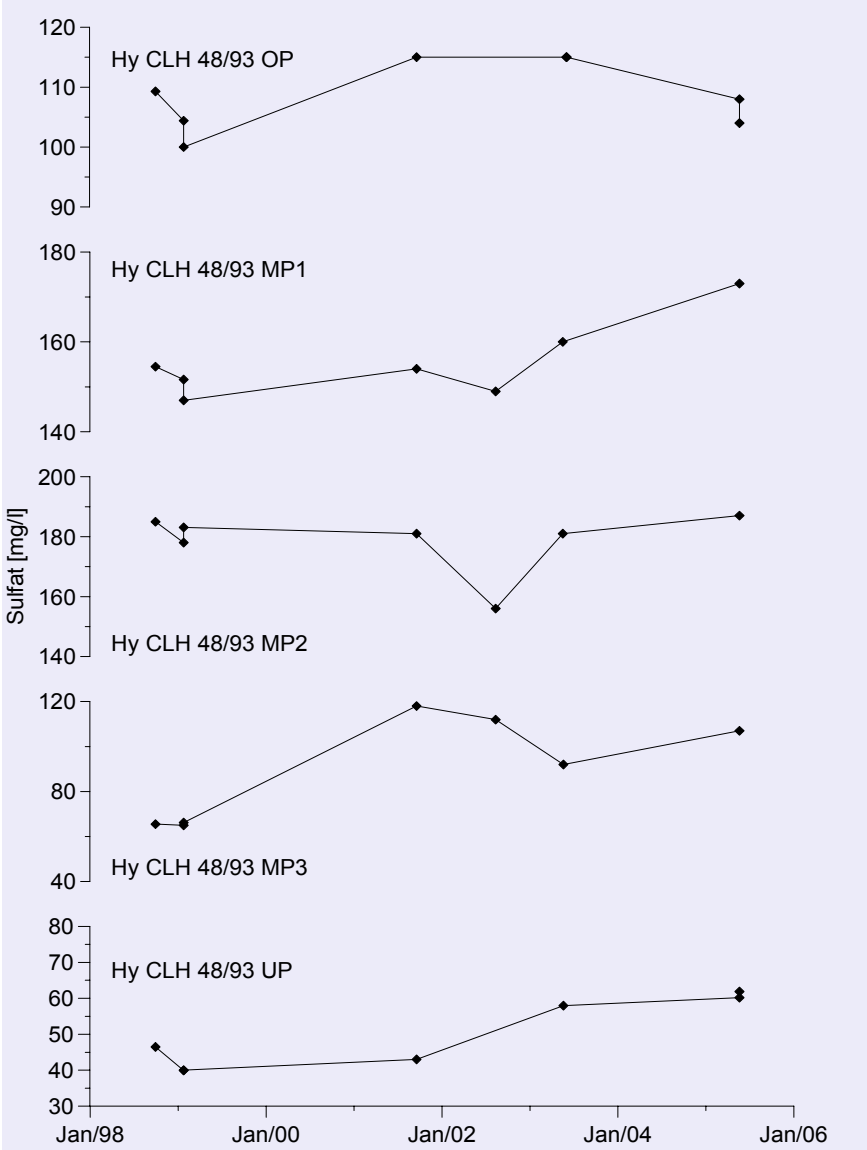
Exposure Focuses

- waste disposal (domestic waste) in the northern part of the training area
- chemical disposal in the southern part of the training area

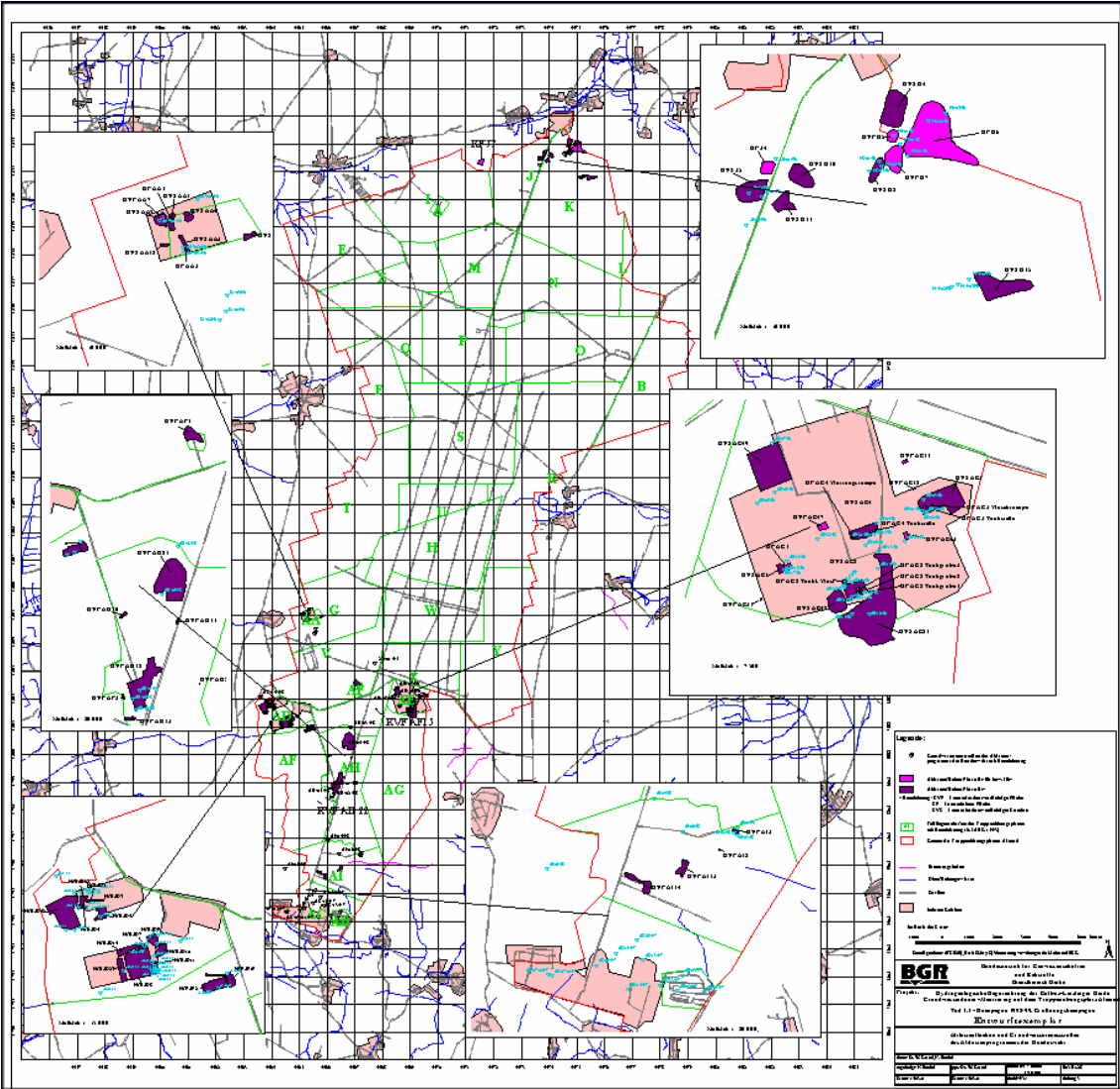
Groundwater Types



Conspicuous Sulphate Contents

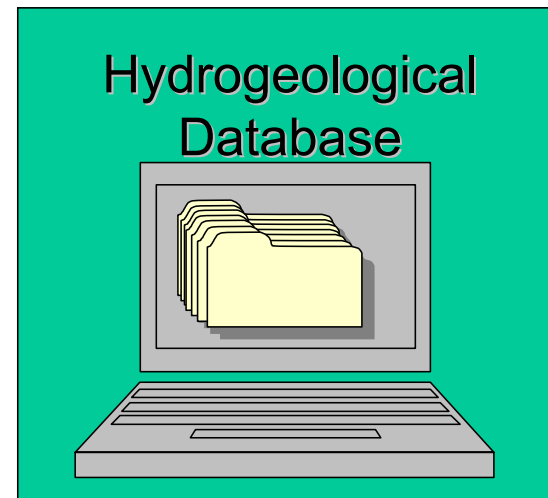
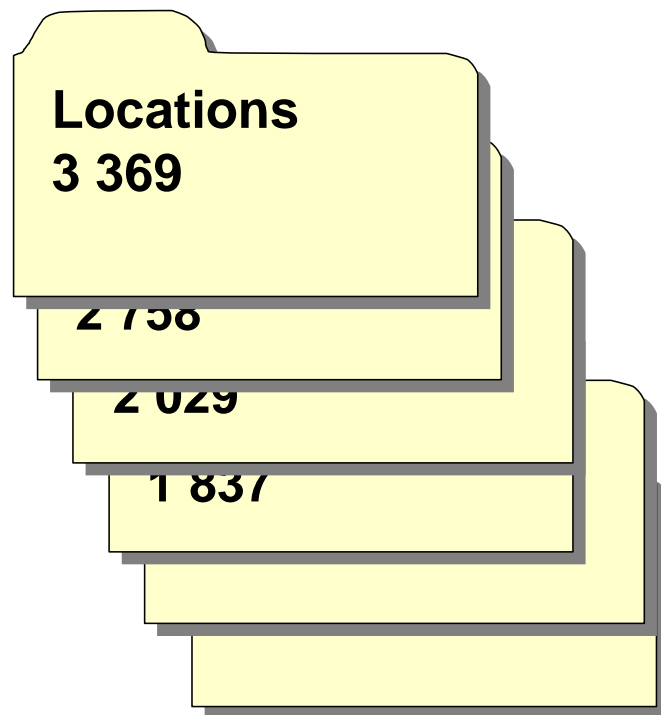


Research Program Of the German Federal Armed Forces on contaminated sites

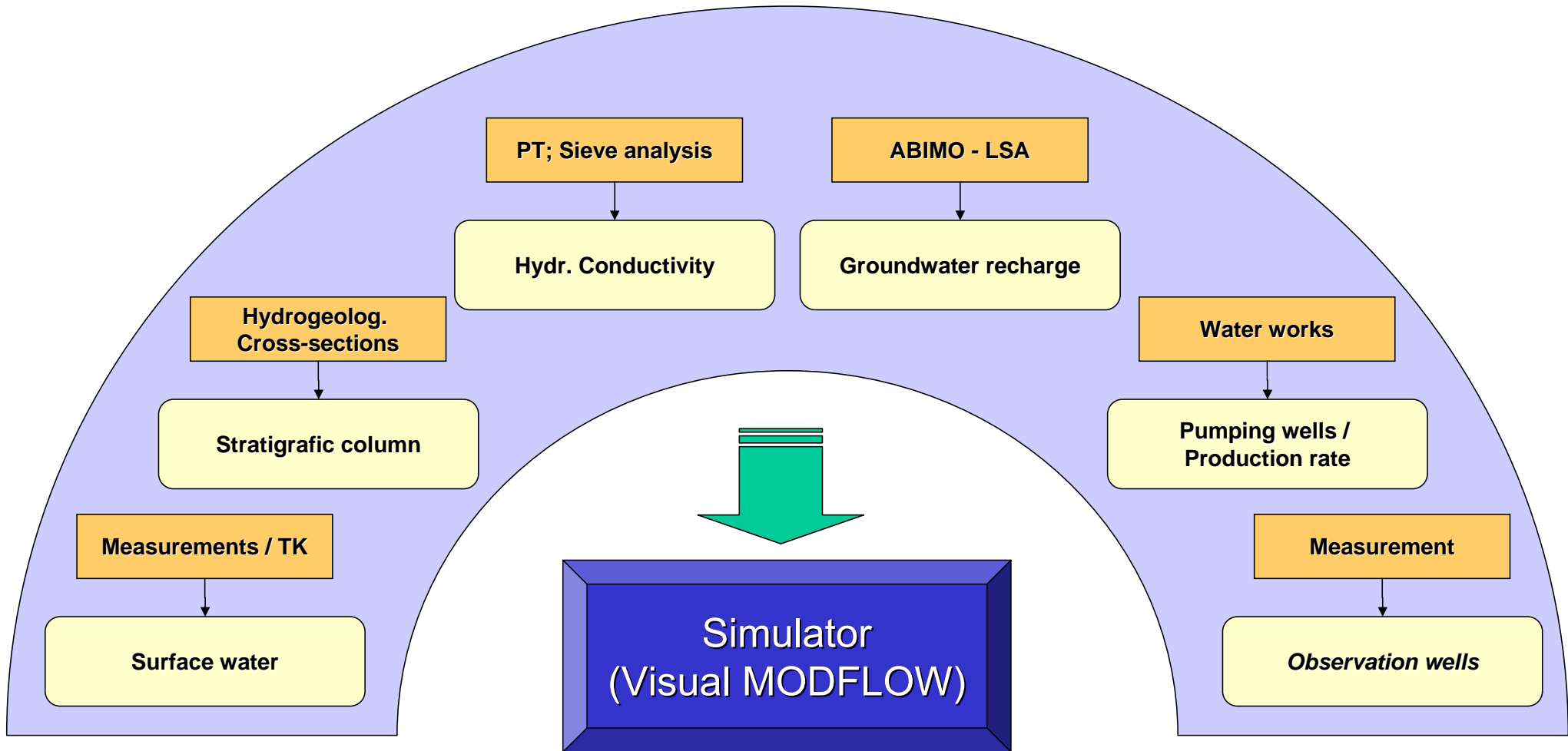


Database

(Sept 2006)

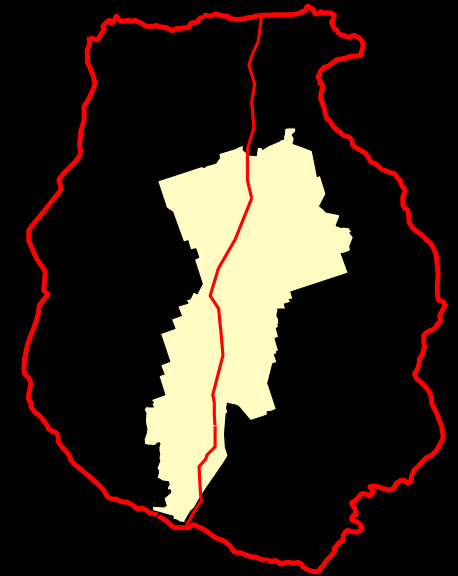
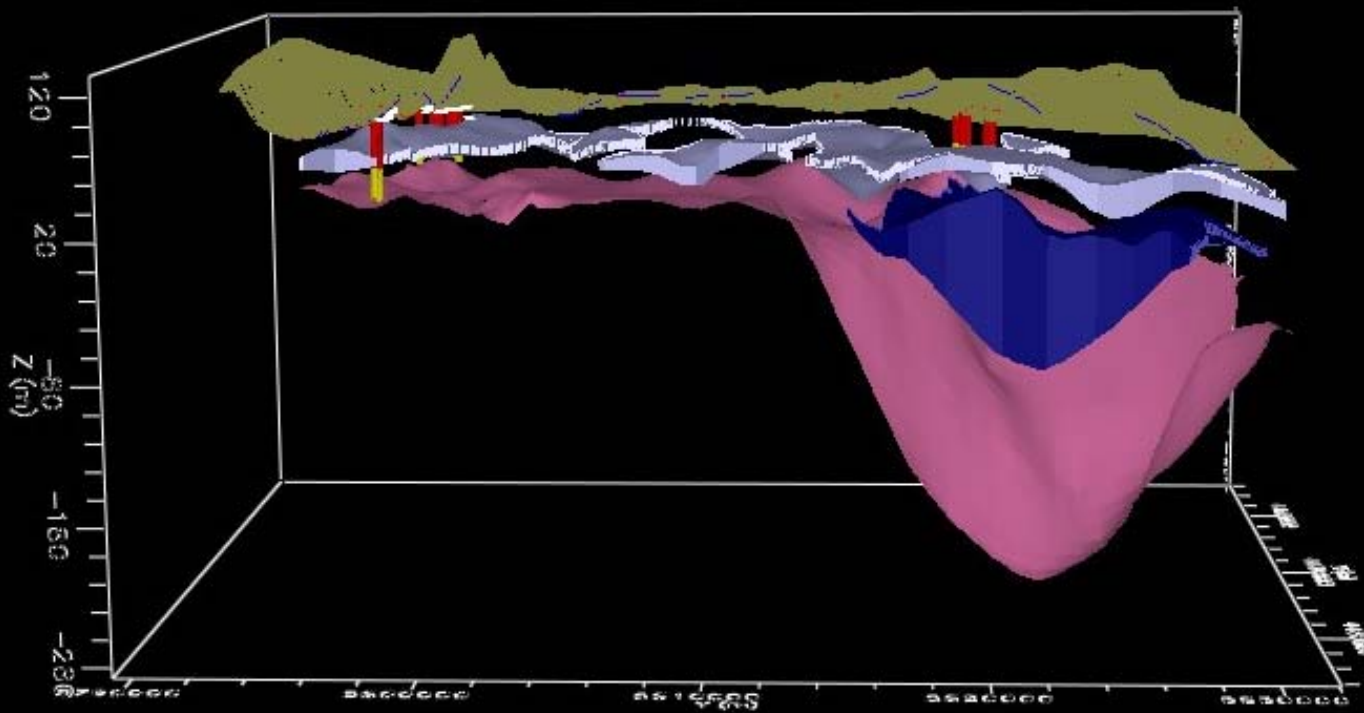


Numerical Modelling



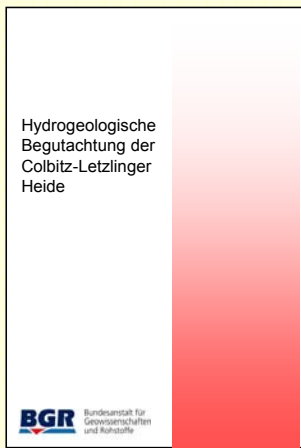
- Scenario / Prognosis:
 - Hydrodynamic
 - Path lines of contaminants

3D-View

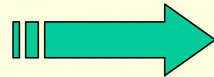


Conclusion

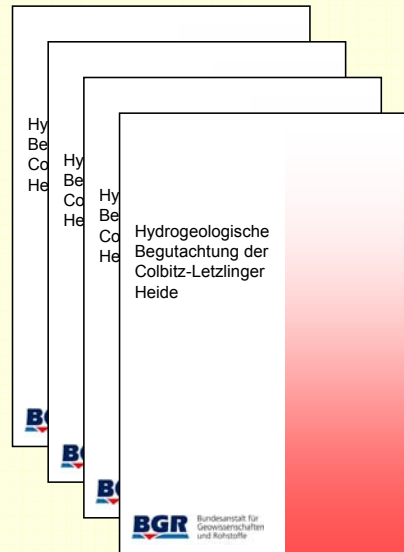
Hydrogeological Report



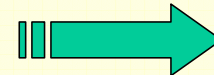
1997



Long-term Groundwater Monitoring 4 Reports



2001, 2002
2005, 2006



Accompanying
GW-Monitoring
for further utilisation

2006-2008

Advice



Several consultations
and discussions



Federal Ministry
of Defence

An aerial photograph of a rural landscape. A large, irregularly shaped field in the center-left is covered in a brown, fibrous material, possibly straw or hay, and is divided into a grid of smaller sections. The surrounding area consists of a patchwork of green and brown fields, some with small structures or buildings. A winding river or stream flows through the lower right portion of the image. The overall scene is a typical agricultural or rural setting.

Thank you for your attention