

Mining- and Environmental Rehabilitation

A sustainable investment into future



Rehabilitation of former state-owned Lignite Mining in Eastern Germany – results and tasks

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Note: All pictures are under authorship of LMBV mbH. www.lmbv.de

Look back on the mining industry of German Democratic Republic



Böhlen bei Leipzig 1989

Serious environmental problems

Bitterfeld 1992



Non-rehabilitated and devastated area on over 30.000 ha (300 km²)

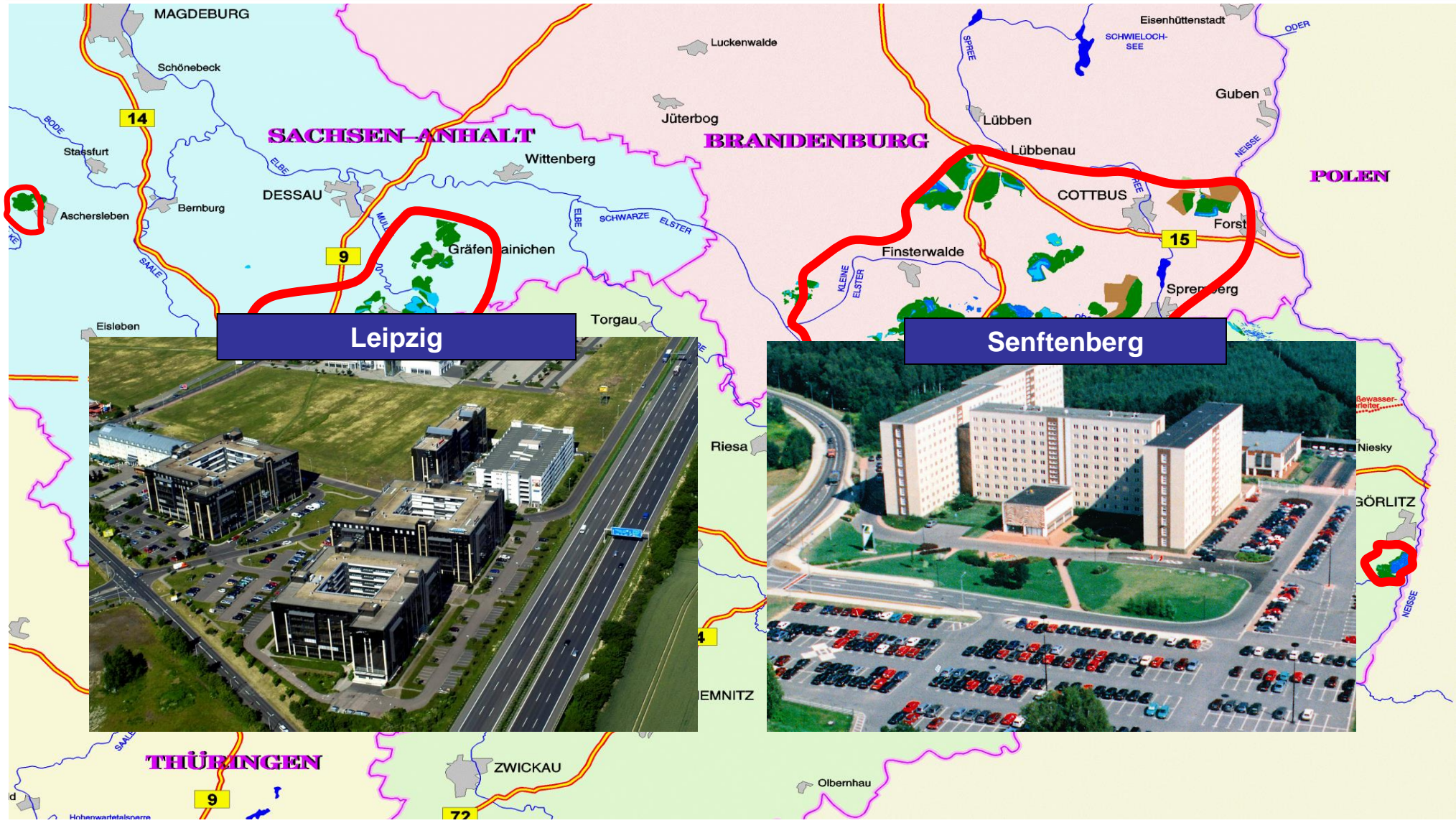


Open pits in direct vicinity to villages

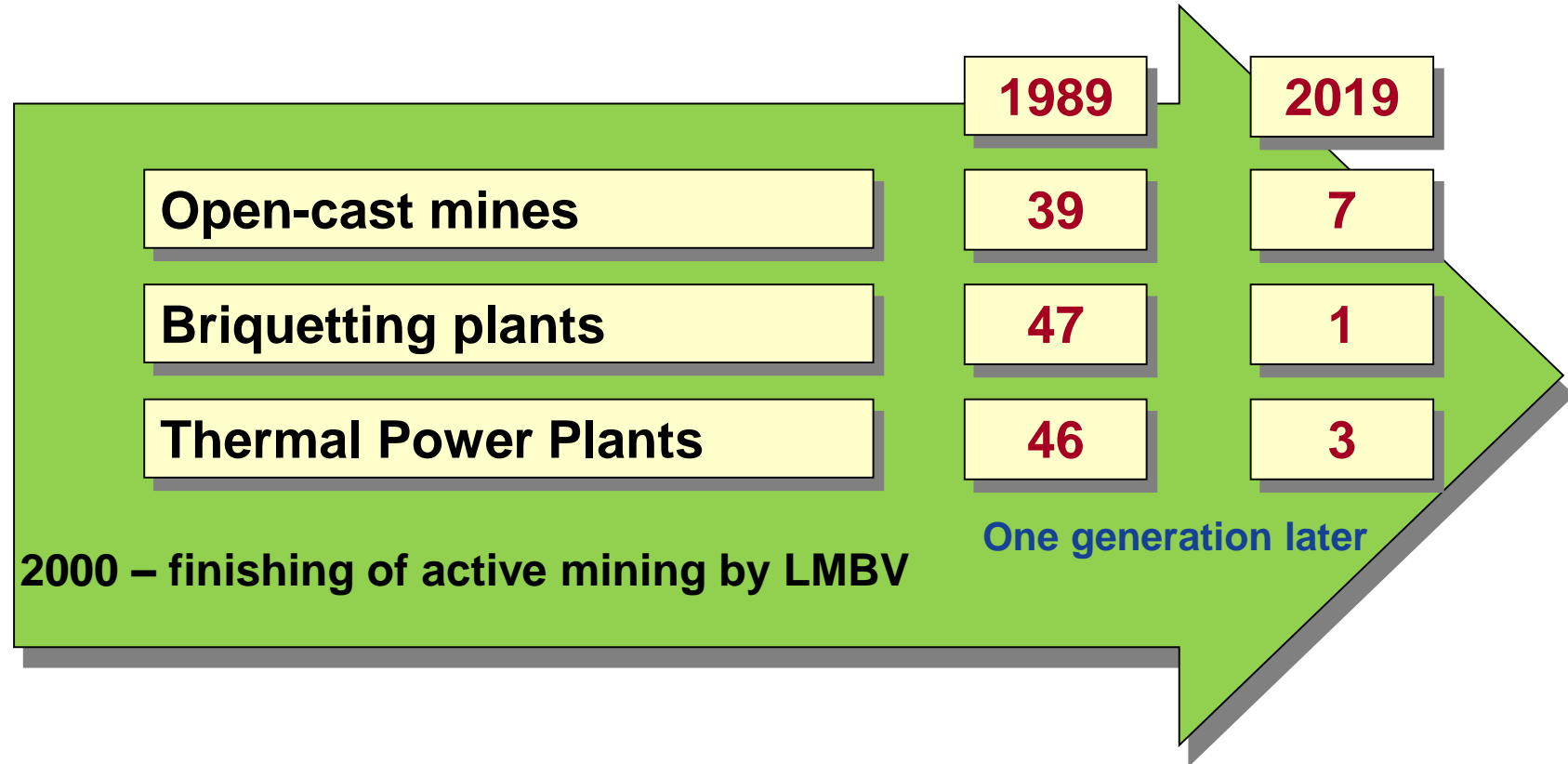


Open pits, unsafe slopes, acid mine water





Responsibility of LMBV



Rehabilitation and re-use of these mining industry sites



Last shift of workers in plants in Lauchhammer

- **LMBV – the company**
- **Involvement of the government and the public in the rehabilitation process**
- **Geotechnical tasks**
- **Rehabilitation of the water household**
- **Groundwater resurgence - conflicts**
- **After use of post-mining landscapes**
- **Conclusion**



- **State owned company (Ministry of Finance)**
- **Responsibility: Decommissioning and rehabilitation of sites used by the lignite mining industry of the GDR**
- **Includes:**
 - **the re-cultivation of dumps feasible for re-use in the public interest**
 - **the restoration of a self regulating water balance according to water quantity and quality**

Starting position for the establishment of LMBV 1995

32 open-cast mining areas with 224 open pits

1.200 km unsecured slopes

13 bill. m³ groundwater deficit with cone of depression of 2000 km²

97.000 ha property of areas used by mining activities

5 active mines to be closed until 3.12.1999

46 refinement- and 42 thermal power plants

app. 1.200 legacy areas

Open-pit Meuro 1997

Involvement and Transparency

Involvement and Transparency in planning and execution process

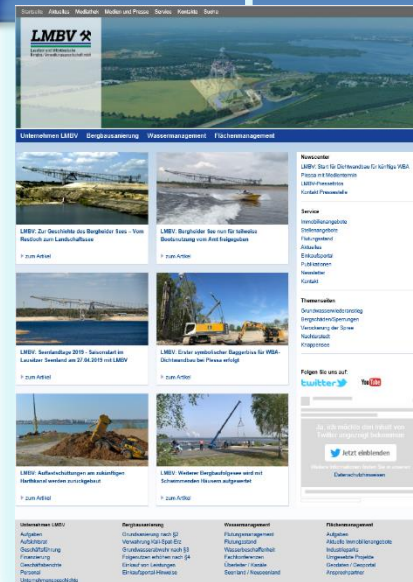
Participation of public interest bodies in planning and approval processes

Regional planning committees
(Regionale Planungsausschüsse / RSB)

Permanent checks by the Federal Audit Office and the Audit Offices of the states

Questions from members of parliament

Scientific conferences on rehabilitation issues



Comprehensive and detailed website presence

Wide range of information materials

Public discussions on rehabilitation topics and necessary steps to solve problems

Information of parties concerned

Guided tours on construction sites

Information of the press

Geotechnical tasks

Geotechnical tasks



Open-cast Meuro 2013

In total: compaction of
1,167 bill. m³ of masses
on LMBV dump slopes

Geotechnical issues



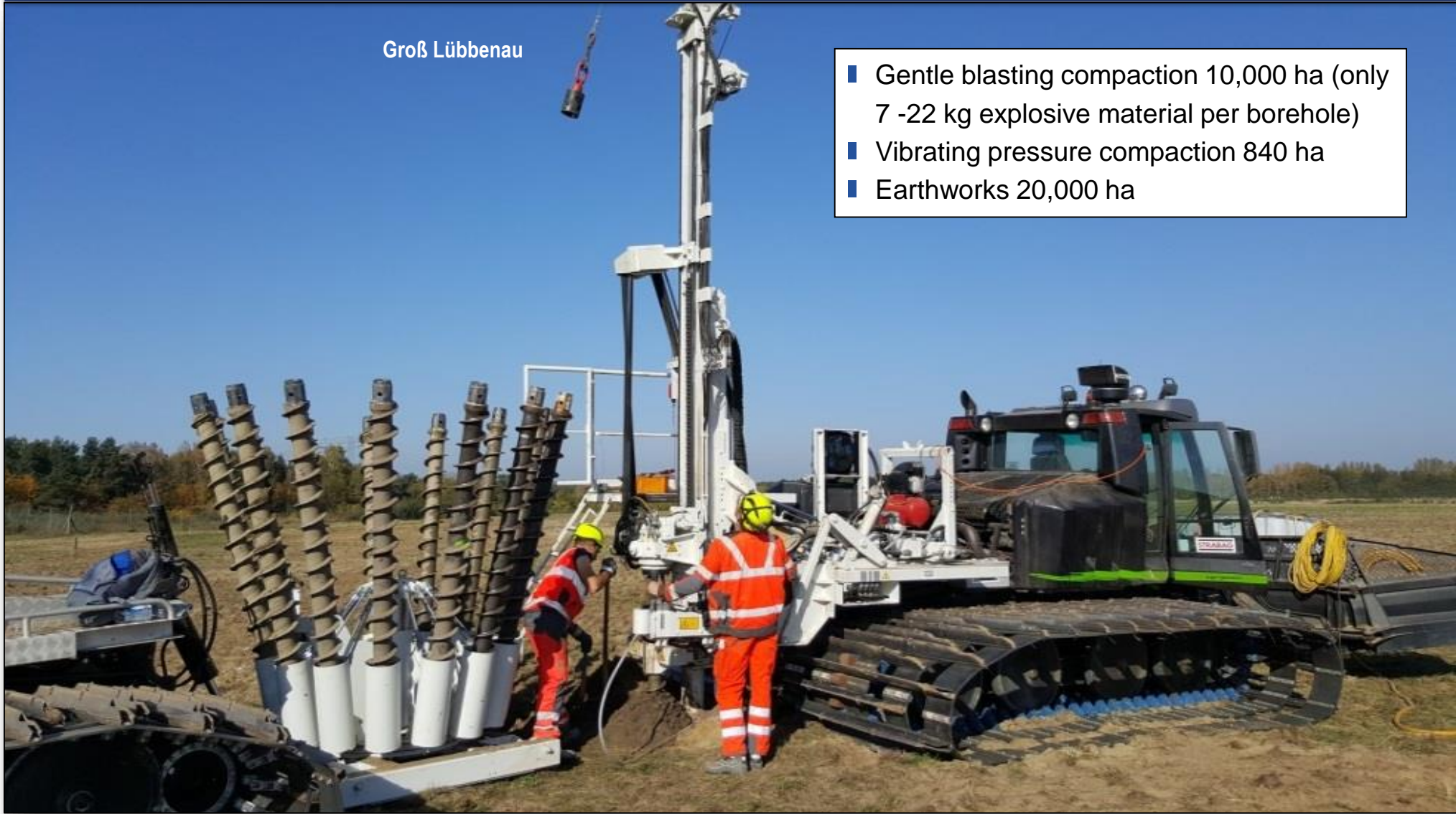
Site collapse inner-dump Spreetal in October 2010, 170 ha



New technology: gentle blasting compaction

Groß Lübbenau

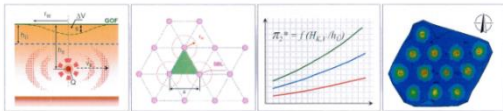
- Gentle blasting compaction 10,000 ha (only 7 -22 kg explosive material per borehole)
- Vibrating pressure compaction 840 ha
- Earthworks 20,000 ha





Handlungsempfehlung für eine „Schonende Sicherung der Kippe mittels Sprengverdichtung“

auf Grundlage wissenschaftlich unteretzter Dimensionierungsregeln und bei praktischen Anwendungen der Sprengverdichtung gewonnener Ergebnisse und Erfahrungen



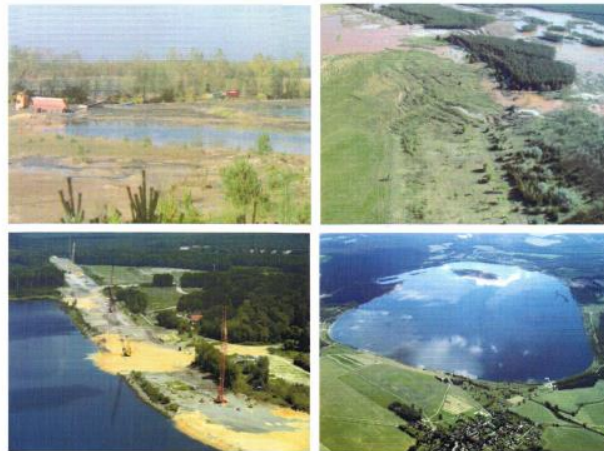
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Dipl.-Geophys. B. Sommer

Freiberg · Februar 2014

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Handlungsgrundlage zur komplexen Bewertung der Innenkippenflächen der LMBV in der Lausitz



Senftenberg, Januar 2015

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Anwenderempfehlung für Belastungsversuche als Bestandteil von Standsicherheitsnachweisen von Innenkippenflächen

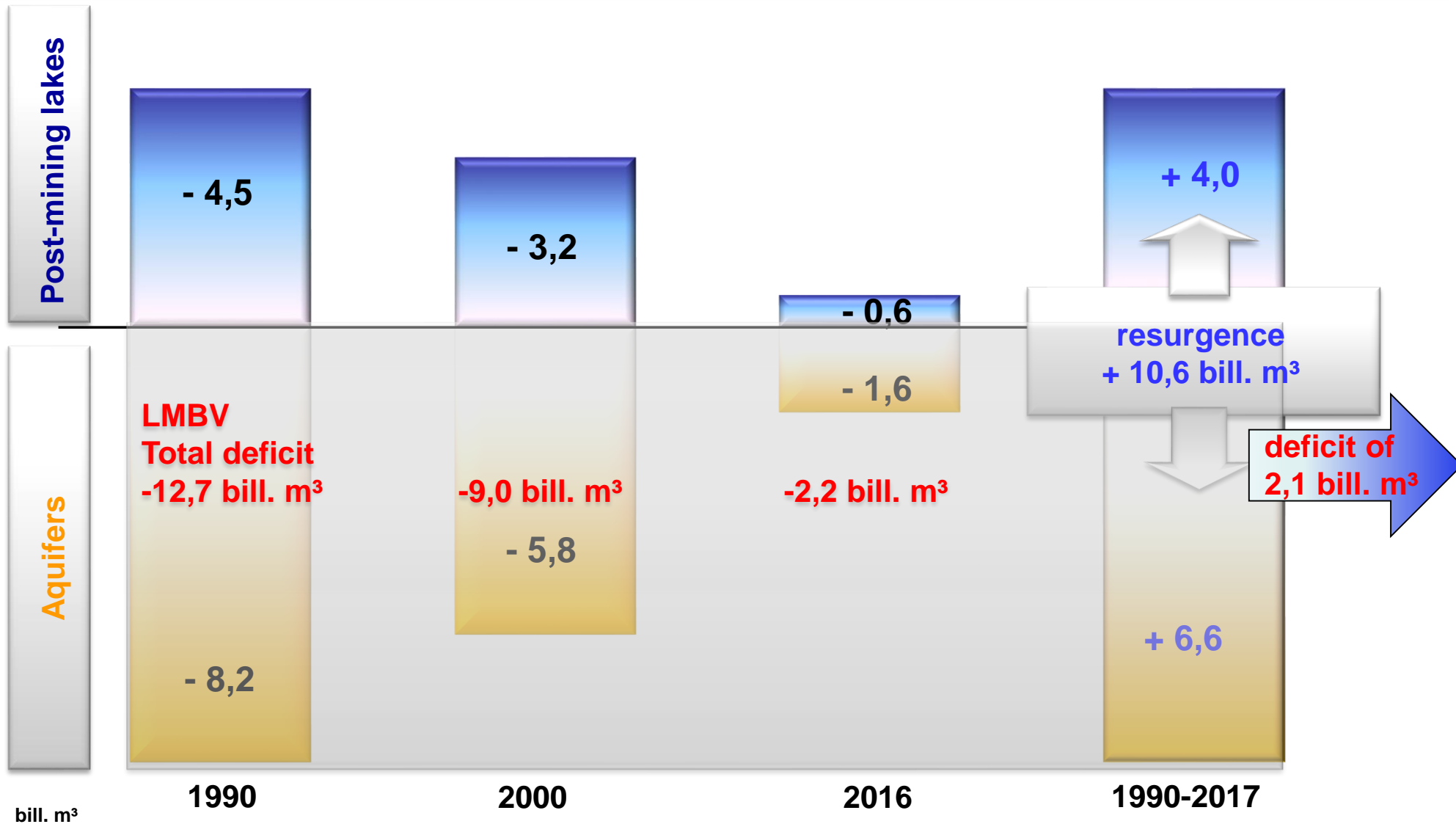


Freiberg, Senftenberg, 09.12.2016

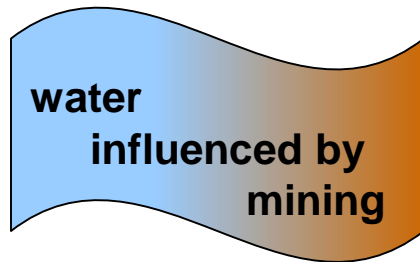
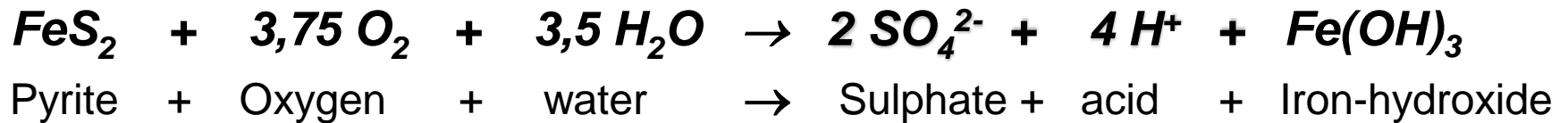
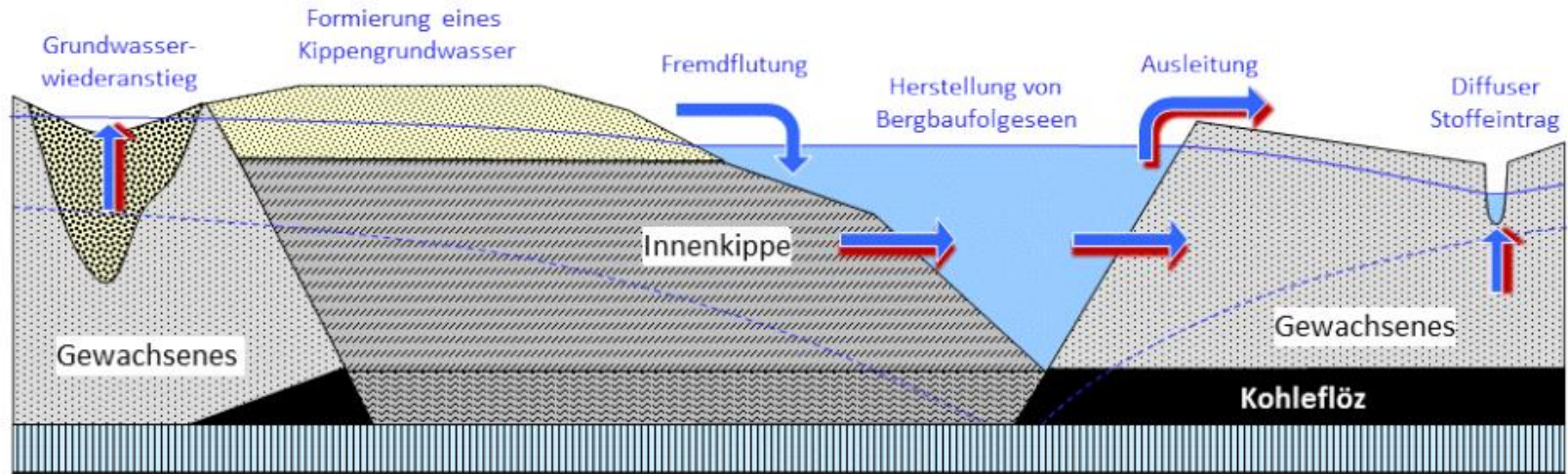
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Rehabilitation of the water household

Groundwater deficit in 1990 and resurgence until 2017



Problems related to quality



- ➔ high sulphate concentration
- ➔ low pH-value
- ➔ high iron concentration

example In-lake-treatment with special rehabilitation boats

Push-boat (Schubboot)

■ length	12,80 m
■ width	5,02 m
■ draught (Tiefgang)	1,05 m
■ weight	23 t

Push-barges (Schubleichter)

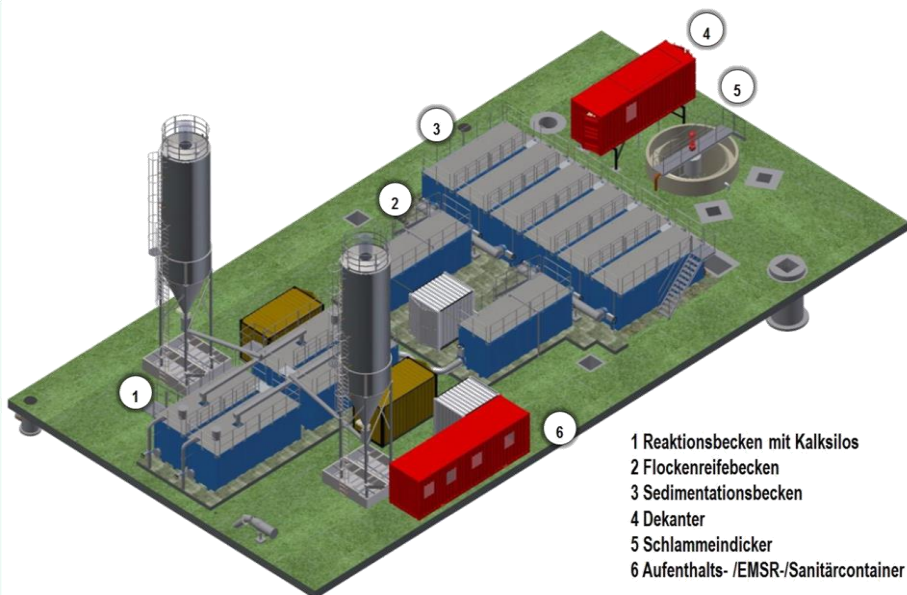
■ length	14,30 m
■ width	5,02 m
■ draught	1,02 m
■ load capacity	25 t lime products



- Commissioning of LMBV-rehabilitation ship „Klara“ am 02.09.2016
- Start of In-lake-Initial neutralisation of lake Partwitz
- In future the whole chain of lakes will be application area

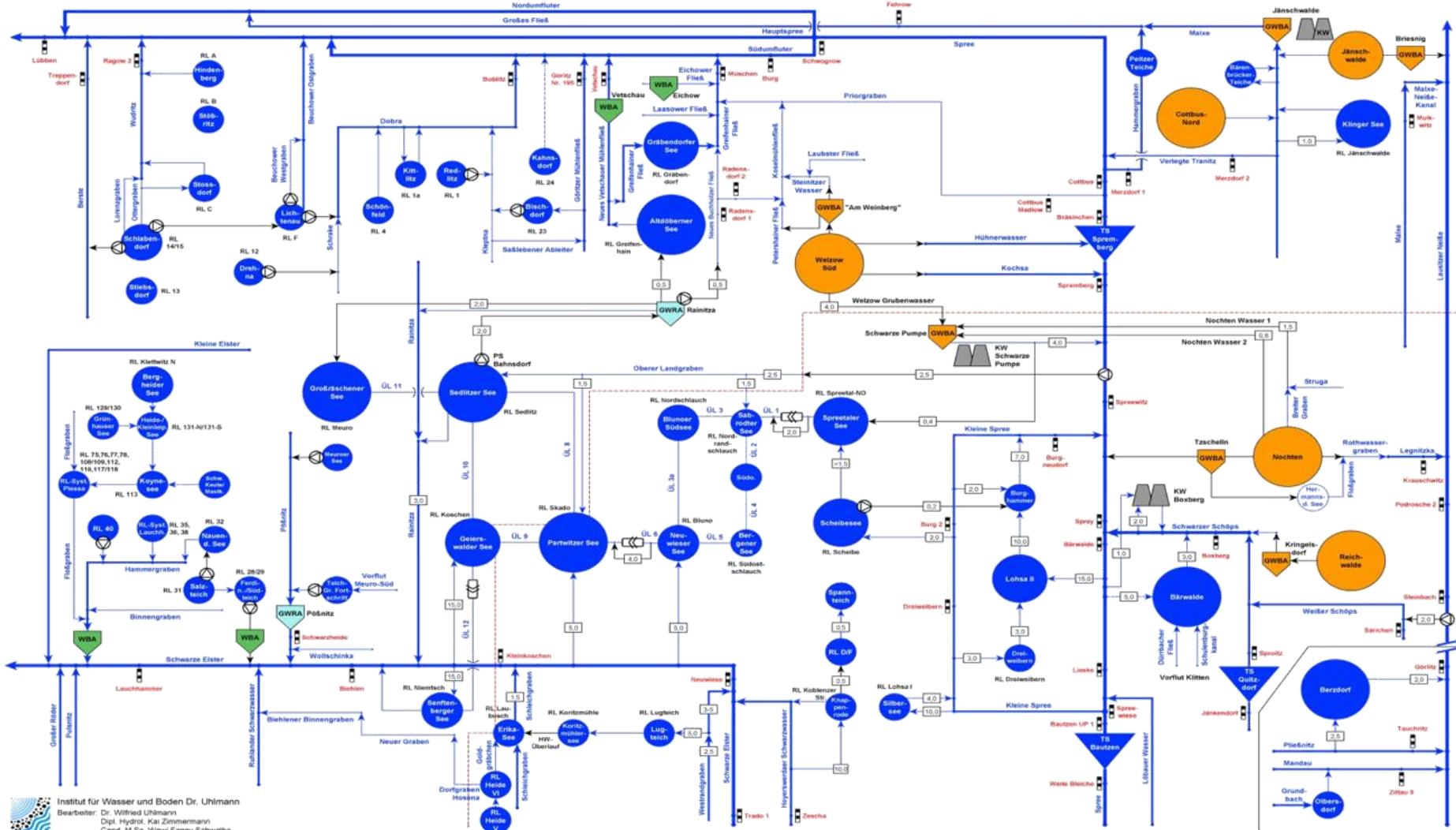
Modern water treatment plants

- Mobile and flexible water treatment plants in the catchment area of rivers
- Avoidance of inflows of acid groundwater into the rivers



Lusatian flooding control centre

Netzstruktur der oberirdischen Gewässer im Lausitzer Braunkohlenrevier
(Planungsstand: 10/2015)



Institut für Wasser und Boden Dr. Uhlmann
 Bearbeiter: Dr. Wilfried Uhlmann
 Dipl. Hydrol. Kai Zimmermann
 Cand. M.Sc. Wavel Fanny Schwalbe



Groundwater resurgence - Conflicts

Area of groundwater lowering

Conflict between groundwater level after mine closure and



Infrastructure

Abandoned mining

Building structure

Legacies

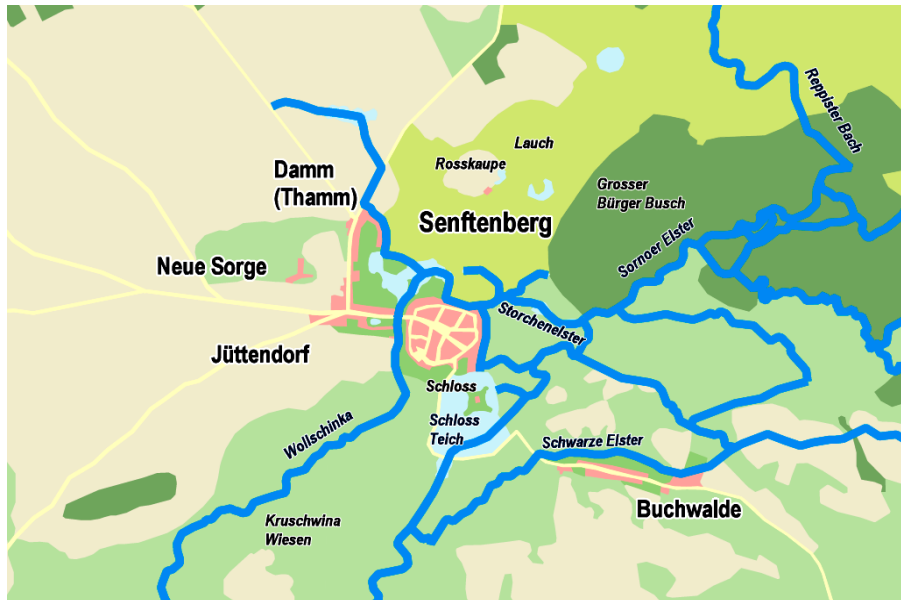
Rivers

app. 5.800 affects, thereof app.
■ 2.400 still activities necessary,
■ 1.400 secured,
■ 1.000 in planning

groundwater resurgence in city Senftenberg

Groundwater lowering as result of over hundred year of lignite mining,
Former receiving waters (trenches, brooks, small rivers) dried-up or were filled and became
construction sites.

um 1850



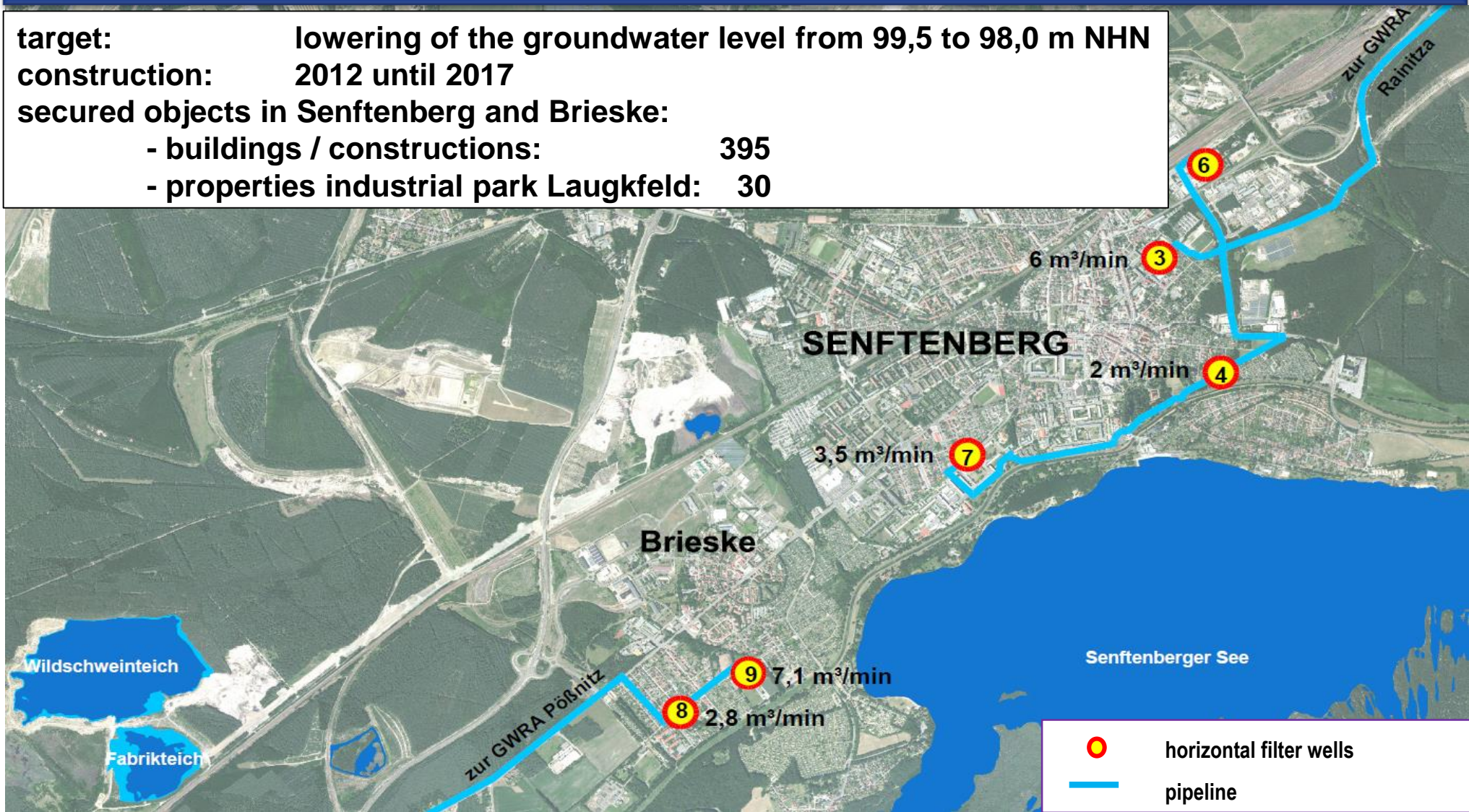
2014



Over 800 buildings had to be investigated

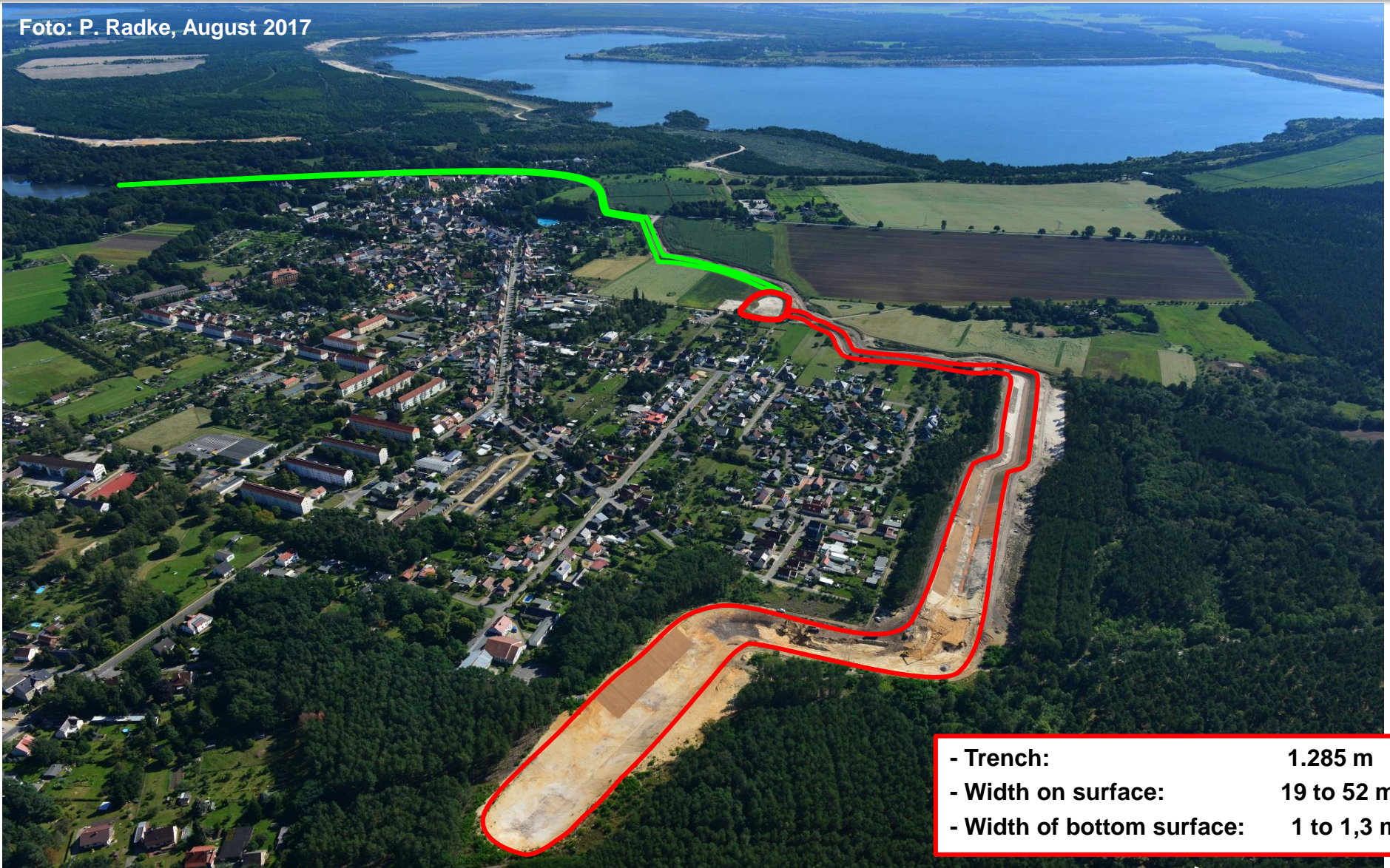
Horizontal-filter-wells in city of Senftenberg und Brieske

target: lowering of the groundwater level from 99,5 to 98,0 m NHN
construction: 2012 until 2017
secured objects in Senftenberg and Brieske:
- buildings / constructions: 395
- properties industrial park Laugfeld: 30



Erection of south trench Altdöbern – securing of 431 objects

Foto: P. Radke, August 2017



- Trench:	1.285 m
- Width on surface:	19 to 52 m
- Width of bottom surface:	1 to 1,3 m

After – use of former mining sites

Afforestation and Nature protection

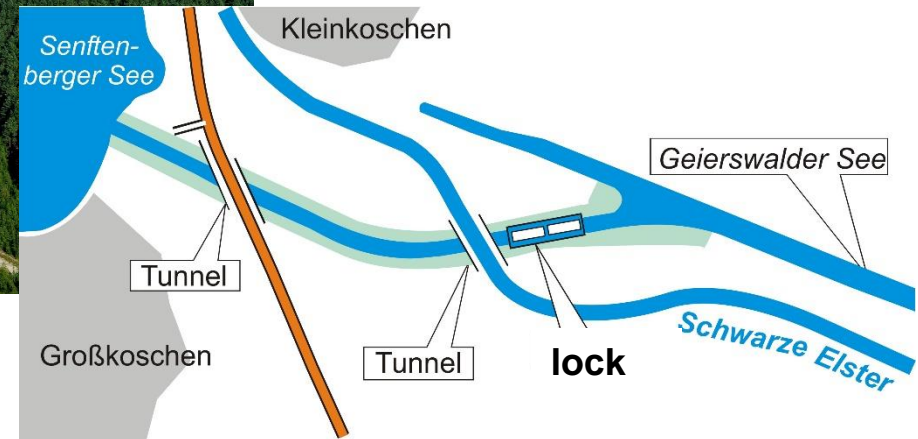


Natural succession

Touristic investments



- Derivation of river Schwarze Elster
- Construction of canal under the river to connect two post-mining lakes
- Tunnel under state road
- Construction of a lock



Touristic Investments



Harbour of Senftenberg

- Public investment and
- Private investments

Touristic investments



Canal and sight seeing point “Rusty Nail”

Touristic Investments



Explanation of rehabilitation work by LMBV during official harbour opening

**Former lignite mine
1921 - 1993**

- Harbour Zwenkau**
- **Public investment**
 - **Private investments**

(Olympic) canoe park near city of Leipzig



Touristic Investments – Ferropolis – Splash festival



Conclusions

- After 25 years of mining rehabilitation by LMBV significant changes are visible:
 - *most of the contaminated sites have been cleaned and re-used by new owners;*
 - *the restoration of a self regulating water balance according to water quantity and quality will be reached. New technologies are developed for securing unstable dump-sites and the treatment of iron-hydroxide contaminated waters;*
 - *former open-cast mines develop into attractive tourist destinations;*
 - *post-mining landscapes are extremely worthy for nature protection goals;*
- Mining rehabilitation on time, during the excavation is necessary for acceptance and far cheaper than starting afterwards.
- Creating a market for rehabilitation is an ongoing success story.
- There are no standard solutions – science & technological innovation are crucial.
- Have visions and underpin the visions with feasible solutions.