

Pit lakes in Germany

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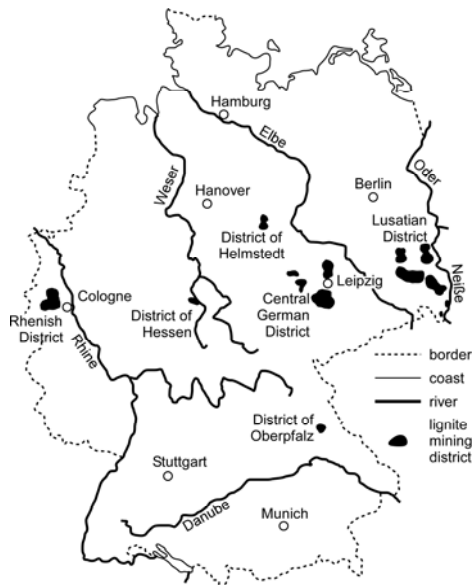
Outline

1. Occurrence and relevance of pit lakes in Germany
2. Hydrological aspects
3. Water quality aspects
4. Beneficial end use of pit lakes
5. Example Lake Cospuden
6. Some interesting publications

Presented at conference „Post-Mining Landscape“, Usti nad Labem, March 11, 2020)

Page 1

Lignite mining in Germany and resulting pit lakes



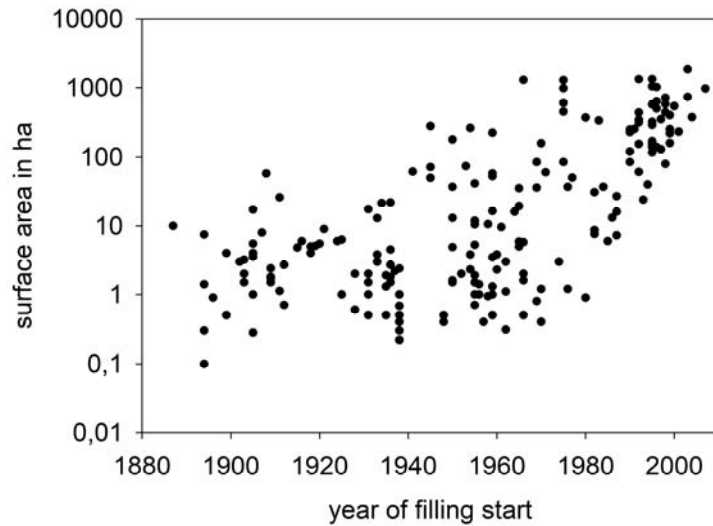
- Production 2019
 - Germany 131 Mt
 - Rhenish D. 65 Mt
 - Lusatian D. 52 Mt
 - Central G.D. 14 Mt

(data from DEBRIV)

- Ca. 575 pit lakes
 - Ca. 370 in Eastern Germany
 - Ca. 120 since 1990
 - The younger, the larger
- (data from Nixdorf et al. 2001)

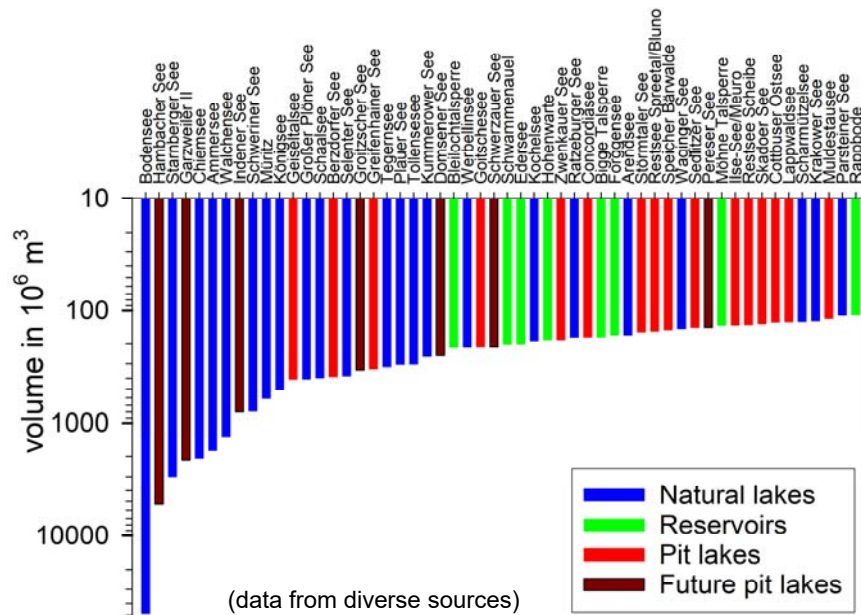
Page 2

Lignite mining in Germany and resulting pit lakes

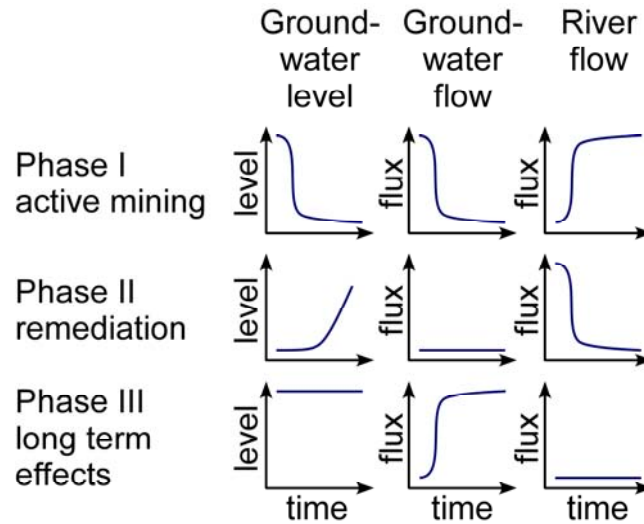


(from Schultze et al. 2013)

Biggest lakes and reservoirs in Germany

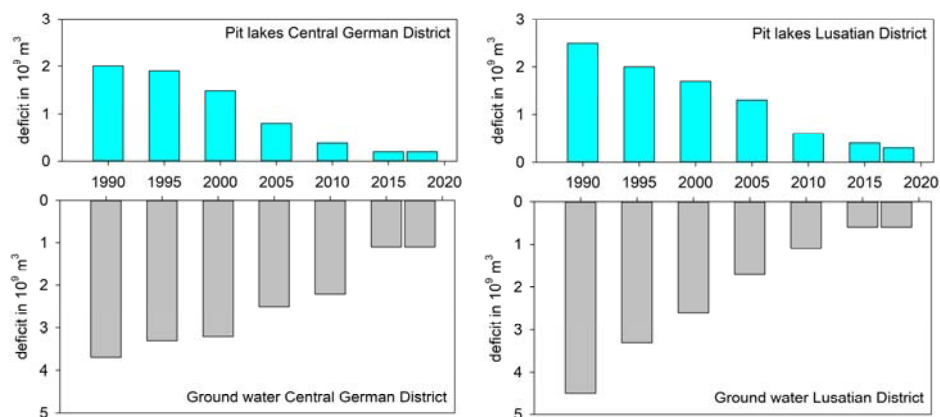


Basic hydrologic situation



Page 5

Water deficit in pit lakes and ground water

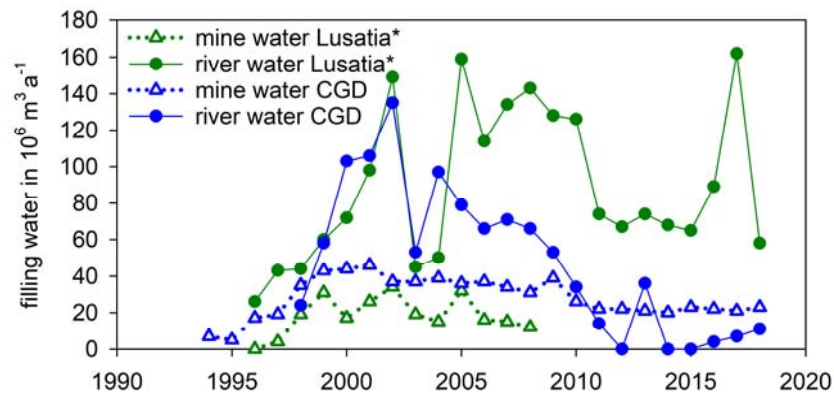


Deficit (ground water + pit lakes): 1990: 8.3 + 4.5 → 2018: 1.7 + 0.5 (in 10⁹ m³)

(data from LMBV)

Page 6

Water used for filling pit lakes

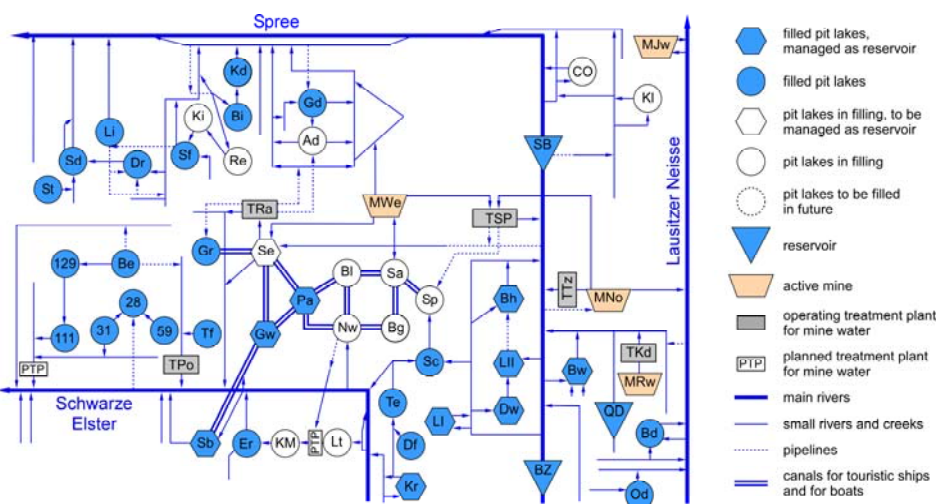


*data for river water include mine water since 2009

CGD – Central German District

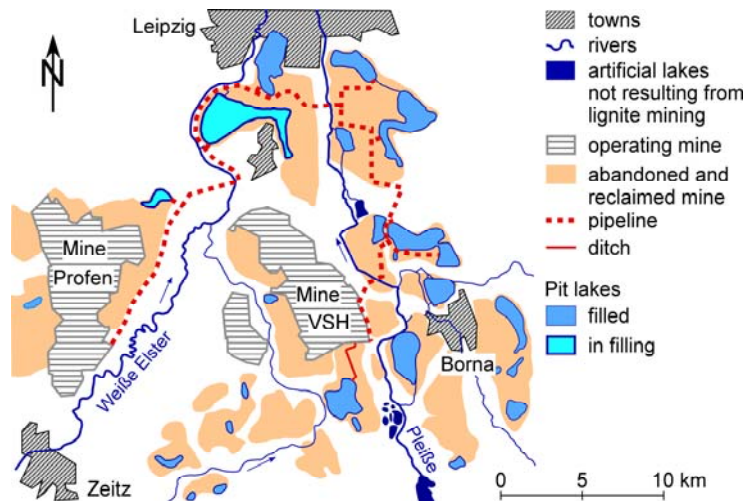
(data from LMBV)

Water management for filling pit lakes in Lusatian District



(redrawn after LMBV)

Mine water for filling pit lakes in Central German District



(from Schultze et al. 2018, adapted)

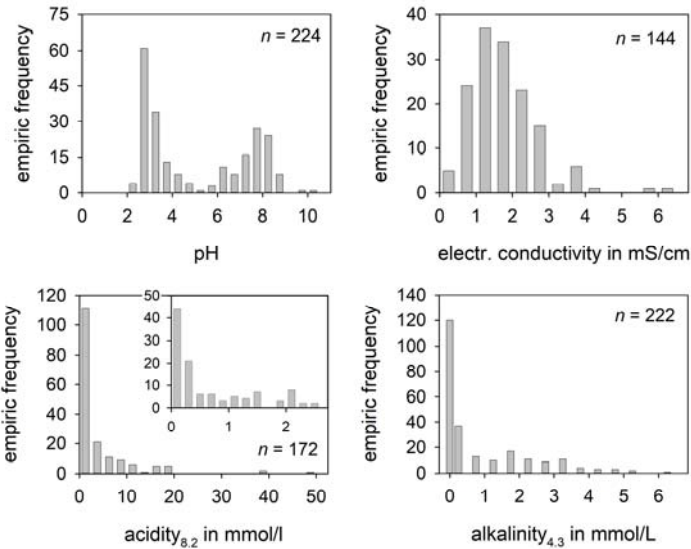
Page 9

Main water quality aspects

- **Acidification caused by pyrite oxidation**
- Eutrophication by nutrients imported with river water or introduced by using the lake (fish-farming, recreation, agricultural land use in catchment area, ...)
- Contamination with trace contaminants from waste deposits, river water or waste water
- Salinization and/or permanent stratification resulting from intrusion of highly saline waters from deeper underground or from pyrite oxidation and acidification

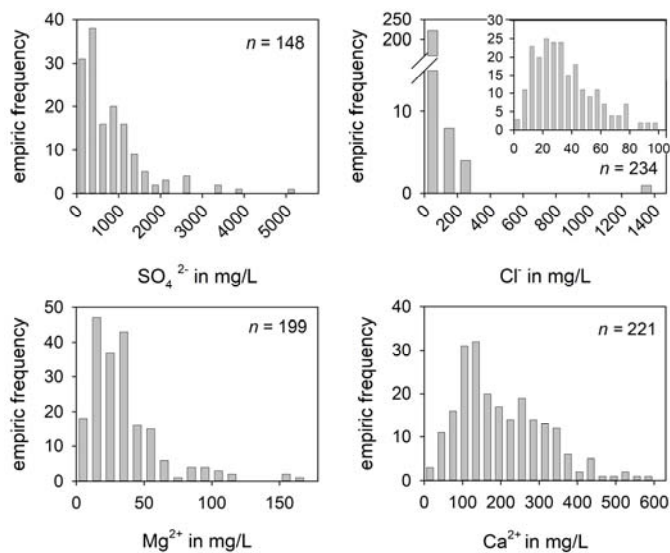
Page 10

Water quality in German pit lakes



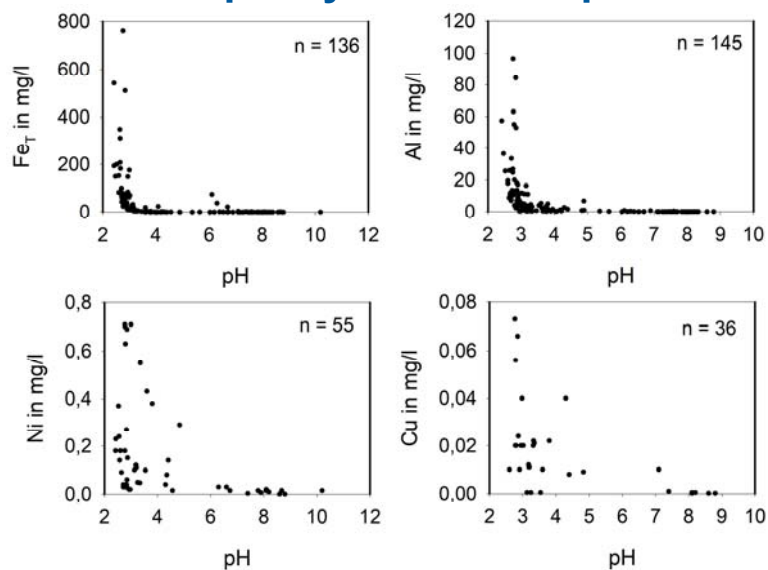
(from Schultze et al. 2013)

Water quality in German pit lakes



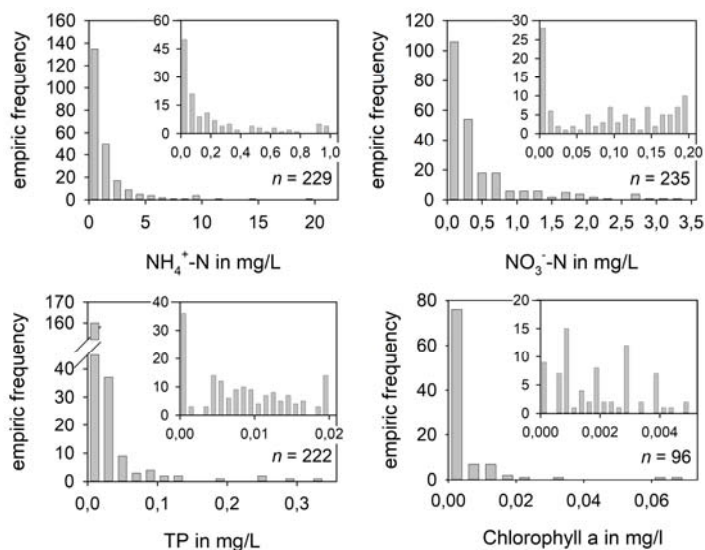
(from Schultze et al. 2013)

Water quality in German pit lakes



(from Schultze et al. 2013)

Water quality in German pit lakes



(from Schultze et al. 2013)

Beneficial end use of pit lakes in Germany (required water quality)

- Water management, flood protection (neutral pH)
- Recreation
 - Swimming, diving, surfing (roughly neutral pH, low productivity)
 - Boating, sailing (not too acidic)
 - Angling (neutral pH)
 - Walking, hiking, cycling, inline/roller-skating, enjoying nature (no particular requirements)
- Nature conservation (wide range possible)
- Fishery (neutral pH, medium productivity)
- Management of waste dump (no particular requirements)

Page 15

Beneficial end use of pit lakes in Germany – further aspects

- Multiple use requires clear ranking and large enough lakes because of competing interests
- Regional agreements between communities and actors should basically be aspired to
- For avoiding problems in areas of nature conservation and to sustain ecosystem services visitors need to be guided
 - Provided infrastructure and location of attractions is guiding visitors more than natural beauty or real value of lakes/locations
- Not each lake will become high level touristic destination due to limited potential of visitors (distance to big cities is highly relevant)

Page 16

Pit lakes used for water management

Pit lake	Storage capacity in 10 ⁶ m ³
Knappensee	6,38
Lohsa I	5,80
Dreiweibern	5,60
Lohsa II	60,53
Burghammer	6,00
Bährwalde	25,00
Sedlitzer + Partwitzer + Geierswalder See	15,00
Senftenberger See	20,50
Zwenkauer See	18,50
Reservoir Witznitz	15,40
Reservoir Lobstädt	0,06
Reservoir Borna	46,10
Muldestausee	35,50
Sum	260,37
(data from diverse sources)	

Some images related to recreation



Bärwalde

Markkleeberg

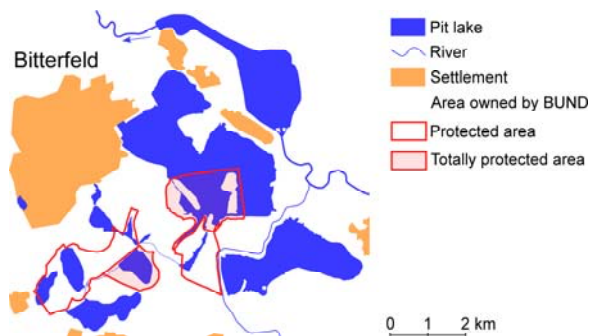
Goitzsche



(photos from LMBV)

Nature reserves owned by NGOs in Germany

- Wanninchen (Lusatia), *Heinz Sielmann Stiftung* (3,300 ha, including 11 pit lakes)
- Grünhaus (Lusatia), *NABU-Stiftung Naturerbe Deutschland* (2,000 ha, including 18 pit lakes)
- Goitzsche Wilderness (Central German District), *BUND* (1,300 ha, including 5 pit lakes)

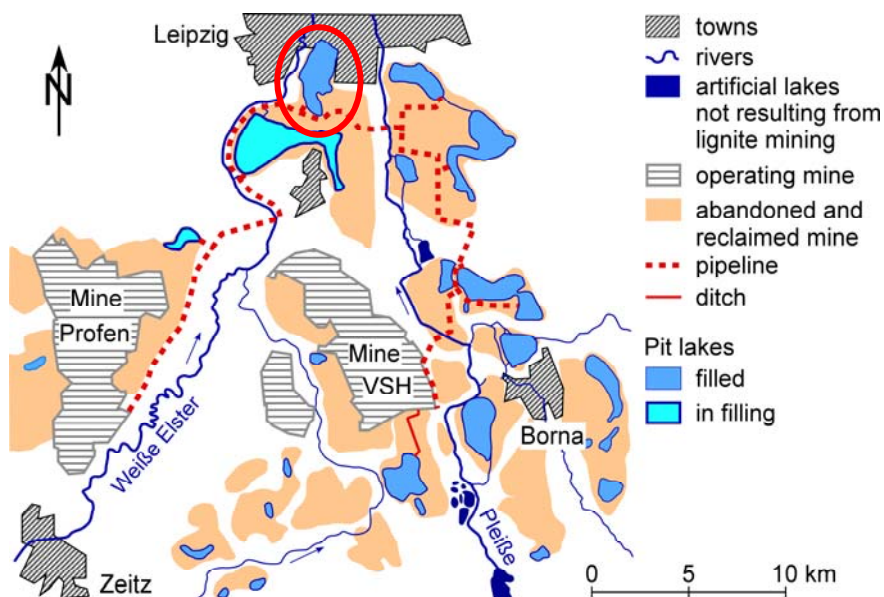


(photo from Heidecke 2015)

UFZ HELMHOLTZ
Centre for Environmental Research

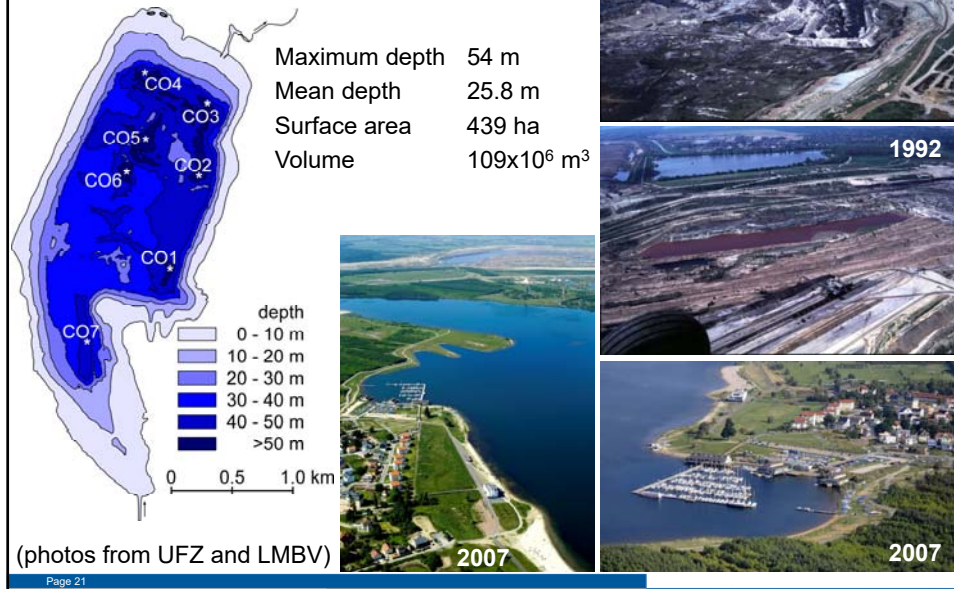
Page 19

Example Lake Cospuden



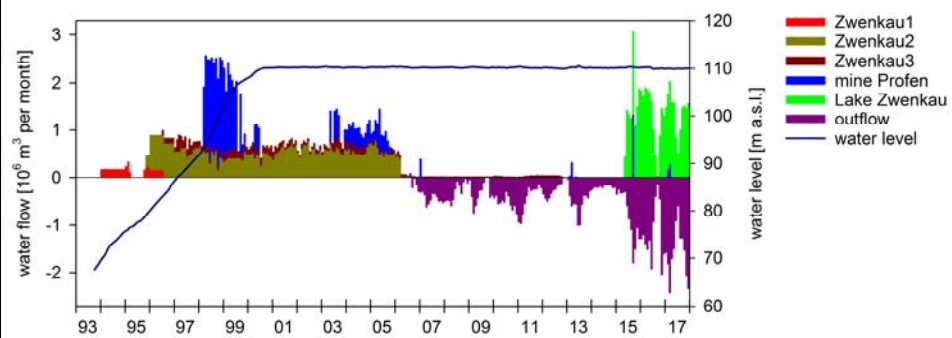
Page 20

Example Lake Cospuden



Page 21

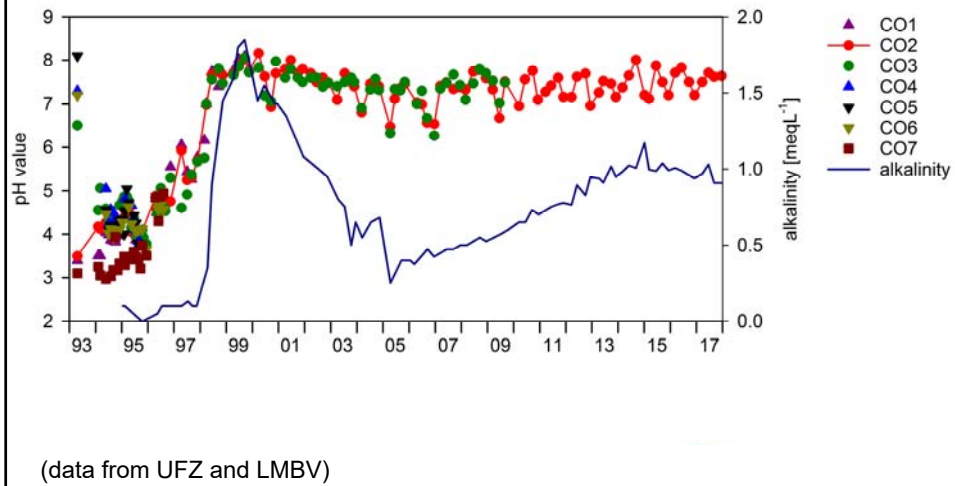
Example Lake Cospuden



(data from UFZ and LMBV)

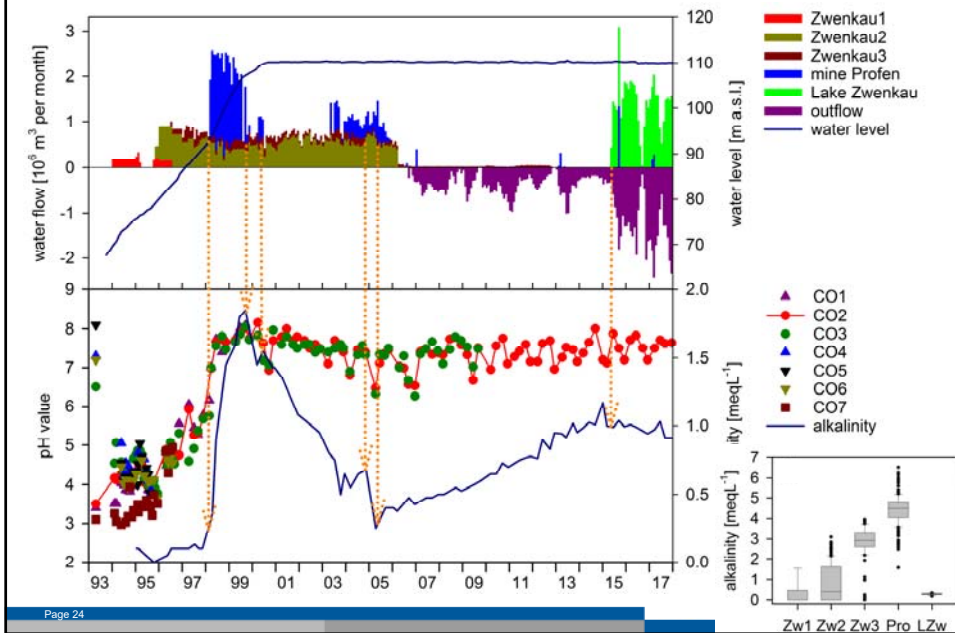
Page 22

Example Lake Cospuden



Page 23

Example Lake Cospuden



GPS-Daten
 1) N 51° 15' 46.4\", E 12° 21' 0.5\"
 2) N 51° 17' 31.2\", E 12° 21' 14.5\"

(from Mitteldeutsche Seenlandschaft - Gewässerkatalog 2019-2021)

Example Lake Cospuden

- Intensive use due to short distance to city center of Leipzig (tram, bus) and good infrastructure
- Separated areas for different types of recreation and nature conservation
- Initially problems due to missing shadow
- Connections for boats to city center and neighboring Lake Zwenkau (future)
- Lake stimulated intense construction activity

Interesting Publications

IN-LAKE NEUTRALISATION OF POST-MINING LAKES
 IN THE LUSATIAN AND CENTRAL GERMAN LIGNITE MINING REGION

STATE OF THE ART
 AND TECHNICAL DEVELOPMENT
 12/2017

DWA-Regelwerk

Merkblatt DWA-M 618
 Erholung und Freizeitnutzung an Seen
 – Voraussetzungen, Planung, Gestaltung

September 2014

Interesting Publications

- Castendyk & Eary (2009) Mine Pit Lakes Society for Mining, Metallurgy, and Exploration
- McCullough (2011) Mine Pit Lakes: Closure and Management. ACG Australian Centre for Geomechanics
- Geller et al. (2013) Acidic pit lakes. Springer
- Oldham (2014) Environmental sampling and modelling for the prediction of long-term water quality of mine pit lakes. UWA Publishing
- Drebenstedt et al. (2014) Braunkohlesanierung. Springer
- Proceedings of the International Mine Water Association
<http://www.imwa.info/imwa-proceedings/proceedings.html>
- Proceedings of conference series Mine Closure
<https://papers.acg.uwa.edu.au/f/mineclosure>

Page 27

Thank you very much for your attention!



(photo: LMBV)

Page 28